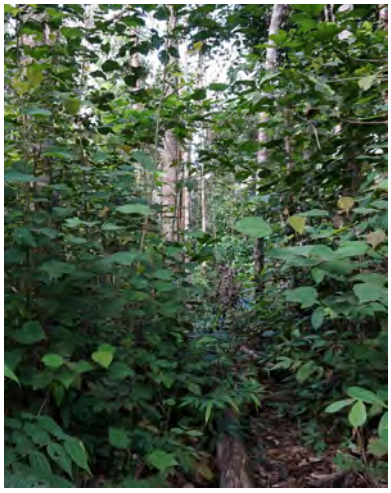
EFFECT OF FIRE ON SILICON AVAILABILITY IN TOPSOILS AND LITTER OF LOWLAND RAINFORESTS AND OIL PALM PLANTATIONS



MASTERARBEIT

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Effect of fire on silicon availability in topsoils and litter of lowland rainforests and oil palm plantations

MASTERARBEIT

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ABBREVIATIONS

ASEAN	Association of Southeast Asian Nations
BSi	Biogenic silicon
C	Carbon
CC	Calibration curve
Ca	Calcium
CBD	Convention on Biological Diversity
CH_4	Methane
CRC	Collaborative Research Centre
DFG	Deutsche Forschungs Gesellschaft
DSi	Dissolved silicon
ENSO	El Niño Southern Oscillation
FAO	Food and Agruicultural Organisation
FFPCP	EU-Forest Fire Prevention and Control Project
FFPMP	Forest Fire Prevention and Management Project
F1	Fire treated at 300 °C
F2	Fire treated at 500 °C
GHG	Greenhouse gas
GTZ	German Agency for Technical Cooperation
HF	Forest core plots
HO	Oil pam core plots
HS	Soil laboratory standard
H_4SiO_4	Mono silicic acid
IFFM	Integrated Forest Fire Management
JICA	Japanese International Cooperation Agency

K	Potassium
LIPI	Indonesian Institute of Sciences
LME	Linear mixed effect models
LOI	Loss of ignition
Mg	Magnesium
N	Nitrogen
Na	Sodium
OH	Hydroxyl
OM	Organic matter
OPEFB	oil palm empty-fruit-bunches
P	Phosphorous
PHKA	Indonesian Ministry of Forestry
RPM	Rounds per minute
S	Sulfur
SE	Standard error
Si	Silicon
TKNKL	National Coordinating Team for Land Fire
TKNPKHL	National Coordination Team for Land and Forest Fire Control
Tmol y^{-1}	Terramol per year
UN	United Nations
UNDP	United Nations Development Programm
UNFCCC	UN Framework Convention on Climate Change
USDA	United States department of Agricultural
wt.-%.	Weight percent

1. ABSTRACT

Deforestation and conversion of rainforests into oil palm plantations in Indonesia is presently increasing, driven particularly by the growing demand of palm oil. This trend goes along with an increase in the frequency of fires, due to the transformation of forest to oil palm (*Elaeis guineensis*) plantations by slash and burn. This study investigated silicon (Si) release from topsoil and litter samples of lowland rainforest and oil palm plantations in Sumatra, Indonesia, and the effect of fire. Thereby testing the hypotheses that topsoils and litter of lowland rainforest and oil palm plantations show higher Si-dissolution rates through burning. Such Si depletion would be highly relevant especially regarding current management practices of oil palm plantations. In addition, it is assumed that topsoils of oil palm plantations show a decreased Si release compared to rainforest topsoils, due to a higher fluctuation of fire events on oil palm plantations. Whereas oil palm litter shows a higher Si dissolution than forest litter, since oil palms are considered to be Si accumulators. The study was conducted on highly weathered loamy Acrisols in the Harapan landscape of Jambi Province, Sumatra, including each three CRC (Collaborative Research Centre) core plots (n = 3) for oil palm plantation and lowland rainforest. Three replicate topsoil samples (n = 3) were taken at 0–1 cm depth in inter-rows of oil palm plantation core plots (n = 3) and in the rainforest core plots (n = 3) that served as reference land-use. Three litter replicates (n = 3) were taken in frond-piles of the three oil palm plantation core plots (n = 3) and in the three rainforest core plots (n = 3). Dried (45 °C, 24 h) and sieved (≤ 2 mm) topsoil aliquots as well as litter aliquots, dried (24 h, 40 °C) and shredded with a plant mill, were burned for 15 min in a muffle furnace at 300 °C (F1) and 500 °C (F2), to simulate a moderate or severe fire event, respectively. Untreated and burned samples were then shaken for 28 h with simulated rainwater, containing ion concentrations typical for rainwater of Jambi Province. Si concentrations were measured in subsamples taken after 5 min, 30 min, 1 h, 2 h, 5 h, 10 h, 21 h, 24 h and 28 h. After 28 h, Si release from untreated (U) forest samples was 20.43 ± 2.37 µg g^{-1} for topsoil and 32.24 ± 7.54 µg g^{-1} for litter, whereas Si release from untreated topsoil samples of the oil palm plantations was 8.1 ± 1.5 µg g^{-1} and for oil palm litter samples 45.68 ± 13.7 µg g^{-1}. Si release after 28 h from fire-treated at 300 °C (F1) samples was 81.28 ± 12.64 µg g^{-1} for forest topsoil and 228.37 ± 62.0 µg g^{-1} for forest litter, whereas Si release from F1 topsoil samples

of oil palm plantations was only 35.19 ± 6.03 µg g^{-1}, but 456.08 ± 199.12 µg g^{-1} from oil palm litter. Si release from fire-treated at 500 °C (F2) samples of forest topsoil was 64.8 ± 4.32 µg g^{-1} and 286.39 ± 82.73 µg g^{-1} from forest litter after 28 h, while Si release from F2 oil palm topsoil was only 44.56 ± 5.87 µg g^{-1}, in return Si release from oil palm litter was 396.52 ± 178.46 µg g^{-1} after 28 h. Thus, fire led to increased Si release. Additionally, the dissolution experiments showed clear differences between sample material and land-use. Results indicate a strong link between the presence of phytoliths and Si release, which are known to be more soluble compared to crystalline soil minerals. Besides, the solubility of Si seems to depend on the current plant species, phytolith age and morphotypes. In addition, the increased Si solubility through burning may be reflected by the amount of soil organic matter (SOM), bound water, hydroxyl groups and OH^-- ion concentration. Considering a large amount of Si accumulated in oil palms, along with increasing palm oil production and, as a result, land-use change by means of fire, significant changes in the biogeochemical Si-cycle can be assumed.

2. INTRODUCTION

2.1 Land-use change in Sumatra, Indonesia

The tropical rainforests are one of the most diverse ecosystems, even when they cover only 7 % of the Earth's surface (ERWIN 1988; MYERS 1988; BIERREGAARD ET AL. 1992). Large parts of tropical rainforests are located in Asia and the Pacific, where the forest area of 734 million hectares was estimated in 2005 (FAO 2007). However, over the last two decades, deforestation rates in the tropical rainforest have rapidly increased (FAO 2007; GIBBS ET AL. 2010; KOTOWSKA ET AL. 2015). The global demand for agricultural products such as food, feed and fuel is vastly growing (TILMAN ET AL. 2001; FOLEY ET AL. 2005; VAN STRAATEN ET AL. 2015) and contributing to deforestation and land-use change as a major driver (GREEN ET AL. 2005; GIBBS ET AL. 2010; UNDP 2015; ALLEN ET AL. 2016). Between 1980 and 2000 more than 55 % of intact forests in the tropics became agricultural land (GIBBS ET AL. 2010). The largest decline in the forest area is recorded in Southeast Asia, with an annual loss of more than 2.8 million ha per year (FAO 2007). Indonesia experienced the greatest loss of tropical forest with almost 1.9 million ha per year (FAO 2007).

Particularly oil palm has become one of the most important agricultural crops in tropical agriculture (TURNER ET AL. 2011; OECD & FAO 2015). Thereby palm oil production has increased worldwide over 300 % between 1985 and 2008 (MURPHY 2009; ALEXANDRATOS & BRUINSMA 2012), and reached a total area of 17 million ha between 2000 and 2012 (PIRKER ET AL. 2016). Indonesia contributes to nearly half of the global production as one of the world's largest producers of palm oil (BASIRON 2007; USDA 2009; FAO 2017). Today, Sumatra covers the largest area of the national oil palm crop, with 75 % of the total oil palm area and 80 % of total palm oil production (USDA 2009). As a consequence, Sumatra experienced a land-use change towards oil palm plantations with a loss up to 7.5 million ha of lowland rainforest from 1990 to 2010, from which 1.1 million ha is located in Jambi Province (MARGONO ET AL. 2012). This loss represents 31 % of the total forest decline in Indonesia (MARGONO ET AL. 2012, 2014). Due to the Indonesian government policies to double oil palm production by 2020, it can be expected that monoculture plantations will continue to dominate the landscape on Sumatra (UNDP 2015).

2.2 Land-use change by means of fire

Traditionally, fire management practices are used to clear land for agricultural production in Indonesia (KETTERINGS ET AL. 1999; EDWARDS & HEIDUK 2015). Yet, forest fires in Indonesia are not only an accompanying symptom of the current land-use change, but have occurred in the Indonesian forest since at least the 17th century (HERAWATI & SANTOSO 2011). Including many naturally caused fires, such as those caused by El Niño Southern Oscillation (ENSO), which induce a prolonged dry period (HERAWATI & SANTOSO 2011). In addition, global warming favors conditions for fires (GOLDAMMER ET AL. 2002). According to the Indonesian government, 2.6 million ha of Indonesian land burned between June and October in 2015, whereby 23 % was located in the provinces of South Sumatra (WORLD BANK 2016). Even though forest fires can be caused by naturally factors, especially in tropical regions (GONZÁLEZ-PÉREZ ET AL. 2004; BENTO- GONÇALVES ET AL. 2012), human activities are the main causes of fires in Indonesia (Tab. 1) (DENNIS 1999; SUYANTO ET AL. 2000; BOWEN ET AL. 2001; GOLDAMMER ET AL. 2002; EDWARDS & HEIDUK 2015). Many small-scale fires are generated by smallholders, who produce 40 % of the country's palm oil (UNDP 2015). However, on a much larger scale, fire is being used by big companies to clear immense areas of vegetation to create oil palm, rubber or timber plantations (KETTERINGS ET AL. 1999). The increasing land-use change since the 1980´s has led to an increase in the extent, intensity and frequency of fires (TACCONI 2003; HERAWATI & SANTOSO 2011). The underlying motivation of forest fires are land-use, land-status, expanding, forestry, and are closely linked to national land development policies (TACCONI 2003; HERAWATI & SANTOSO 2011). Apart from that, fire practices like slash and burn are very cheap means and for most of the smallholders the only practice to clear land available (KETTERINGS ET AL. 1999; GOLDAMMER ET AL. 2002; WORLD BANK 2016).

Tab. 1: Hectares burned in Indonesia by land-type in 2015 (modified from WORLD BANK 2016).

Land-type	Hectares burned (%)
Mining	1
Food crops	14.27
Estate crops	3
Palm oil concession	20.85
Forestry concession	9.62

Swamp Forest	7.26
Natural Forest	10.7
Others	33.3

2.3 Impacts of land-use change by means of fire

Numerous studies have shown that land clearing related fires have manifold negative impacts on the environment. Forest conversion leads to substantial losses in biomass (e. g. ADACHI ET AL. 2011; VAN STRAATEN ET AL. 2015; KOTOWSKA ET AL. 2015) and biodiversity (e. g. MALHI & GRACE 2000; GREEN ET AL. 2005; FOLEY ET AL. 2005; FITZHERBERT ET AL. 2008; SODHI ET AL. 2009; WILCOVE ET AL. 2013; BARNES ET AL. 2014; TEUSCHER ET AL. 2016), reduces soil nitrogen (N) availability (e. g. ALLEN ET AL. 2015), and thereby influences the soil-atmosphere exchange by reducing the uptake of methane (CH_4) from the atmosphere into the soil (e. g. HASSLER ET AL. 2015). Furthermore, forest conversion decreases aboveground and belowground organic carbon (C) stocks (GUILLAUME ET. AL 2015, 2016) especially due to the burning of biomass (e. g. MALHI & GRACE 2000; VAN STRAATEN ET AL. 2015; KOTOWSKA ET AL. 2015), causing anthropogenic greenhouse gas (GHG) emissions (e. g. GONZÁLEZ- PÉREZ ET AL. 2004; UNDP 2015). Agriculture, deforestation, and other land-use changes have been the second-largest contributors of emissions, generating 24 % of global GHG emissions in 2010 (BLANCO ET AL. 2014), which in return affects human health through air pollution (e. g. KETTERINGS ET AL. 1999). Soil is particularly affected by land-use changes.

2.4 Effect of fire on soil

Soil is a fundamental component of terrestrial ecosystems and as such closely related to ecosystem functions and productivity (DEBANO ET AL. 1998). The heating of soil during a moderate or severe fire, such as those usually used in land management practices, affects soil in terms of biological, physical and chemical properties (GONZÁLEZ-PÉREZ ET AL. 2004; NEARY ET AL. 2005; CERTINI 2005). The extent and duration of soil properties changes occurring during a fire are directly related to fire frequency and severity, soil type, magnitude and soil depth as well as heat intensity and transfer (BADÍA & MARTÍ 2003; NEARY ET AL. 2005; WANTHONGCHAI 2008; CERDÀ & ROBICHAUD 2009; MERINO ET AL. 2018).

During a fire heat is transferred downward into and through the soil, raising its temperature (CERTINI 2005). The highest temperatures are reached at / or near the soil surface (CERTINI 2005; MERINO ET AL. 2018). Whereby the effects of fire are

mainly taken place in the first centimeters of soil, below 2 cm fire has little or no effects on the soil properties (MALLIK ET AL. 1984; CERTINI 2005; BADÍA ET AL. 2014; FRANCOS ET AL. 2018). Alongside soil depth, the soil temperature reached during a fire is an important factor for changes in soil properties (GREENBERG ET AL. 2006; STOOF ET AL. 2010). The so-called threshold temperature (DEBANO ET AL. 1998) indicates the respective temperature at which physical, chemical, and biological properties irreversibly change (Fig. 1) (NEARY ET AL. 2005).

Biological properties of soils are most sensitive to soil heating, disruption begins at 40–70 °C (DEBANO ET AL. 1998; NEARY ET AL. 2005). By contrast, changes in physical or chemical properties of the soil occur at much higher temperatures. Temperatures between 220 and 460 °C combust soil organic matter and affect soil properties as described below (DEBANO ET AL. 1998; STOOF ET AL. 2010). Heating above 460 °C causes the loss of hydroxyl (OH) groups from clays and thus sharply decreases the porosity of clays (GIOVANNINI ET AL. 1988). Consequently, the more intense the fire, the greater the change in soil properties.

Besides, forest and land fire causes a loss of soil structure, reduces soil aggregate stability, increases bulk density and reduces infiltration rates (BADÍA & MARTÍ 2003; NEARY ET AL. 2005; CERDÀ & ROBICHAUD 2009; RAISON ET AL. 2009; HERAWATI & SANTOSO 2011). Farther fire affects the microclimate by increasing soil surface temperatures, affecting soil aeration and water transport (ONWUKA 2018). However, the most common chemical processes occurring in soils that are affected by fire are mainly involved in the mechanism of aboveground and belowground ecosystem nutrient cycles (NEARY ET AL. 2005; CERDÀ & ROBICHAUD 2009; RAISON ET AL. 2009). During a fire the organic matter combusts and decreases the protective organic litter layer (CERDÀ & ROBICHAUD 2009). As a consequence, nutrients are either volatilized and lost to the atmosphere or change from non-plant available sources to highly available forms (Fig. 1) (. NEARY ET AL. 2005; WANTHONGCHAI 2008; CERDÀ & ROBICHAUD 2009). These soluble forms can be taken up readily by plants, however, they are primarily lost by leaching, surface run off and erosion (NEARY ET AL. 2005; WANTHONGCHAI 2008). Moreover, the combustion of organic matter releases soluble cations and reduces soil acidity (NEARY ET AL. 2005). The increase in soil pH likewisely solubilize previously non-plant-available nutrients (GIARDINA ET AL. 2000). Thus fire events allow short-term replenishment of soil fertility (DEBANO ET AL. 1998; KETTERINGS ET AL. 1999), but on a long-term perspective they cause a considerable

loss of nutrients (NEARY ET AL. 2005; CERTINI 2005; CERDÀ & ROBICHAUD 2009; HERAWATI & SANTOSO 2011). Long-term studies concerning the impact of wildfire on soil, as conducted e. g. by FRANCOS ET AL. (2018) and BADÍA ET AL. (2014), show a decrease in overall soil nutrient content with time as a consequence of the inability of nutrients to recover their pre-fire levels.

Depending on the plant species and ecosystem affected by fire as well as the fire temperature, the nutrient type and quantity impacted by fire varies (Fig. 1) (QIAN ET AL. 2009; PEREIRA & ÚBEDA 2010; BODÍ ET AL. 2014; NGUYEN ET AL. 2014). At low to moderate fire (< 450 °C), combustion is incomplete and the ash is still organic-rich, with organic carbon being the main component (BODÍ ET AL. 2014). At severe fires (> 450 °C), most organic carbon is volatized and the remaining ashes consist of inorganic constituents, mainly Calcium (Ca), Magnesium (Mg), Potassium (K), Silicon (Si), and, in lower proportions, Phosphorous (P), Sodium (Na), Sulfur (S), and other metals (QIAN ET AL. 2009; PEREIRA & ÚBEDA 2010; NGUYEN ET AL. 2014).

Most of these constituents are very well studied, whereas Si has for a long time been disregarded in studies about fire impact on soils (SAVANT ET AL. 1999; EPSTEIN 2009; UNZUÉ- BELMONTE ET AL. 2017). Although being a quantitatively major inorganic constituent of higher plants, Si has not been proven to be an essential element for higher plants, but is rather considered as beneficial to the plants health (EPSTEIN 1999, 2009; FAROOQ & DIETZ 2015). However, in recent years the global biogeochemical Si-cycle has attracted attention, not only because of the closely linked processes of weathering of silicate minerals and CO_2 transfer to the lithosphere (CONLEY 2002), but also regarding its value improving crop productivity (EPSTEIN 1999; MA ET AL. 2001), especially in temperate as well as tropical countries (KORNDÖRFER & LEPSCH 2001).

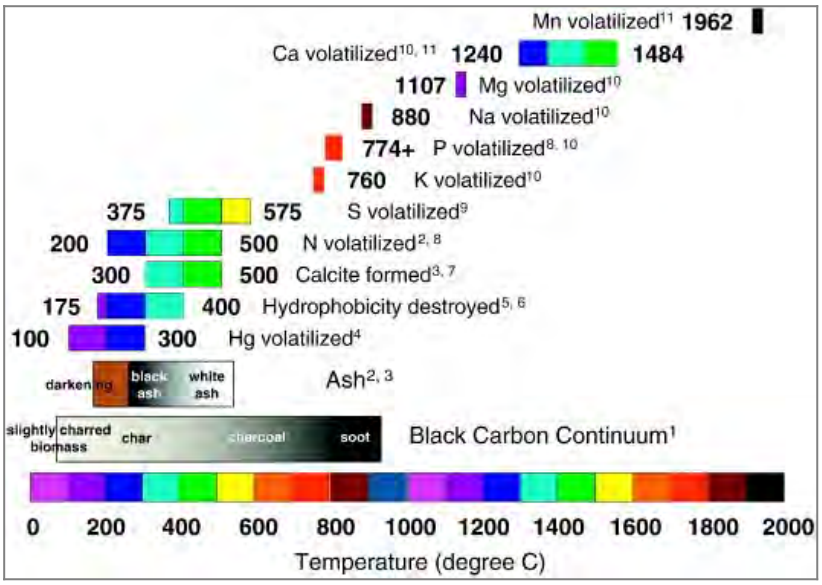


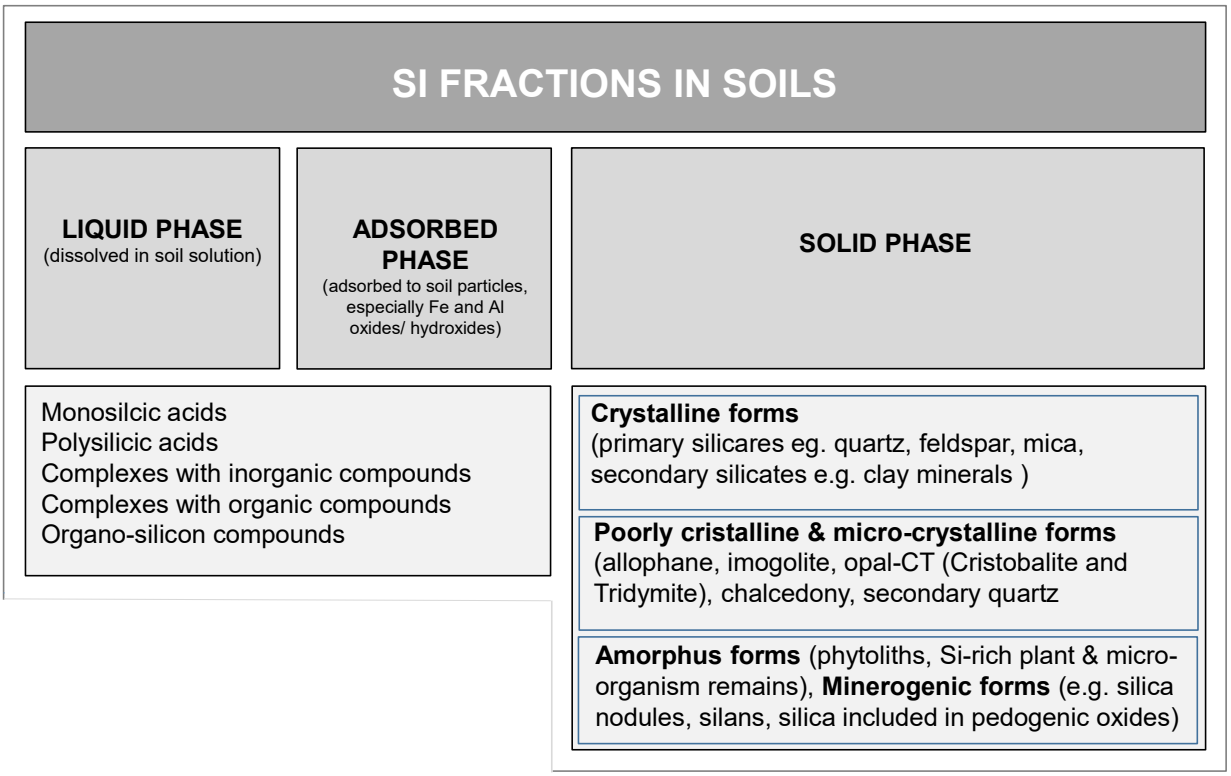
Fig. 1: Major temperature thresholds that affect ash and soil chemistry (adapted from BODÍ ET AL. 2014).

2.5 Silicon in soils

Si is the seventh most abundant element in the universe and the second most abundant element in the earth crust (Epstein 1999; Tréguer & De La Rocha 2013; Xiao et al. 2014; Treguer 2015; Klotzbücher 2016; Tubana et al. 2016). The original source of Si in the environment are primary minerals (Klotzbücher 2016), since the major part of all minerals are silicates (Mackenzie & Wollast 1983). Si in soil occurs as solid, liquid and adsorbed phase fractions with different water solubility and reactivity (Fig. 2) (Sauer et al. 2006; Tubana et al. 2016).

The solid Si phase consists of poorly crystalline and microcrystalline, crystalline and amorphous forms (Sauer et al. 2006; Tubana et al. 2016). The pre-dominant Si forms are crystalline, mainly as primary (e. g. feldspar, mica, olivine) and secondary silicates (e. g. clay minerals), and silicate materials such as quartz (Tubana et al. 2016). Amorphous Si forms arise either as litho / pedogenic forms (silica glass, opal-A, silans) or biogenic forms (phytoliths, Si-rich plants and microorganisms) (Matichenkov & Bocharnikova 2001). The liquid and adsorbed phase fractions of Si consist of mono silicic acid (H_4SiO_4), and polysilicic acids (Raven 1983; Klotzbücher 2016; Tubana et al. 2016).

Si is initially released during weathering of primary silicates (McKeague & Cline 1963; Cornelis et al. 2011; Klotzbücher 2016). Moon et al. (2014) estimate a global silicate weathering rate (Ca + Mg silicate weathering flux) of ~ 2.17 (2 σ range of 1.59 – 2.75) × 1012 mol / yr. Especially soils under humid-tropical climate undergo intensive chemical weathering and element leaching (Zech et al. 2014). Desilication, i. e. Si leaching from the soil system, is one of the dominant soil-forming processes in the humid tropics and provide H_4SiO_4 to the soil solution (Zech et al. 2014). Sommer et al. (2006) expected the highest recent desilication from young soils on ultrabasic rocks in tropical humid climates. Since Si release is part of the weathering processes, Si concentration in soil solution depends on the solubility of primary and secondary Si compounds in soils, which in turn is conditioned by parent material, soil type, soil development, depth and temperature (Sommer et al. 2006; Georgiadis et al. 2013). For instance, Cambisols



or Alfisols have high Si plant cycling, moderate weathering rate of minerals, and low Si leaching out of the system, whereas Podzols have low Si biological cycling, high weathering of minerals, and high Si leaching from the system (Lucas 2001).

The dissolved Si (DSi) in soil solution can be adsorbed by soil particles and built complexes with Al, Fe, or other metals and soil organic matter (FARMER ET AL. 2005) or is readily taken up by plants and deposited as a solid amorphous Si fraction in cell walls, cell lumens or in extracellular locations (ALEXANDRE ET AL. 1997; MA ET AL. 2001; SANGSTER ET AL. 2001). These amorphous Si fractions in plants are known as opal phytoliths, plant phytoliths, opaline Si or biogenic Si (BSi), in the literature on wildland fire or heating likewise known as “mineral ash” (ALEXANDRE ET AL. 1997; SMITH ET AL. 2010). SOMMER ET AL. (2006) estimated the total phytogenic Si in soils higher than 3 wt.-%. Thereby phytoliths in soils and living terrestrial biomass constituted to the largest fraction (65 %) of the continental reactive Si reservoir (LARUELLE ET AL. 2009). According to LARUELLE ET AL. (2009) large amounts of DSi are annually transformed into BSi, both on land (89 Tmol y^{-1}) and in the oceans (240 Tmol y^{-1}). Through plant death and litter-fall BSi is returned to soils, which in turn represents a major source of DSi in soil solution (ALEXANDRE ET AL. 1997; DERRY ET AL. 2005; CORNELIS ET AL. 2010;

Fig. 2: Si fractions in soils (modified from SAUER ET AL. 2006).

NGUYEN ET AL. 2014). ALEXANDRE ET AL. (1997) estimated the Si release from BSi two to three times as great as that from silicate weathering. Si release trough weathering is a slow process, whereas the high solubility of phytoliths compared to crystalline soil minerals provide a fast and important source of DSi in soil solution (FRAYSSE ET AL. 2006; CORNELIS ET AL. 2010).

Whether released by weathering or recycled from BSi, available Si content in soil is an important nutrient for the growth of silicophilic plants (XIAO ET AL. 2014; NGUYEN ET AL. 2014). Besides a higher crop quality and yield, high accumulation of Si protects plants from biotic and abiotic stresses in form of improved resistance to insect pests and pathogens, drought, soil salt content and heavy metal tolerance (MA & TAKAHASHI 2002; ROMERO-ARANDA ET AL. 2006; XIAO ET AL. 2014; MA & YAMAJI 2015).

Si concentration differ considerably among and within species (EPSTEIN 1999; MA & TAKAHASHI 2002; GOCKE ET AL. 2013). The studies of MA & TAKAHASHI (2002) consider plants with Si concentrations higher than 1.0 % and a Si/ Ca ratio higher than 1.0 to be Si accumulators. In general, monocotyledons accumulate more Si than dicotyledons (AHMAD & RASOOL 2014). For these species (e. g. rice (*Oriza sativa L.*), sugar cane (*Saccharum officinarum L.*) and other grasses) typical leaf Si concentrations under adequate Si supply are about 6 % and 2.5 %,

respectively (SAVANT ET AL. 1999; MA & TAKAHASHI 2002). Regarding the classification scheme of MA & TAKAHASHI (2002), oil palms (Fig. 3) ought to be considered as a Si accumulating species as well (MUNEVAR & ROMERO 2015) (Fig. 4). MUNEVAR & ROMERO (2015) measured leaf Si concentrations in oil palms higher than 0.91 % with a mean value higher than 2.0 % and a maximum of 4.07 % (Fig. 4). As a result, silicon availability plays an important role within the tropics, where a majority of the production plants are determined as Si-accumulators.

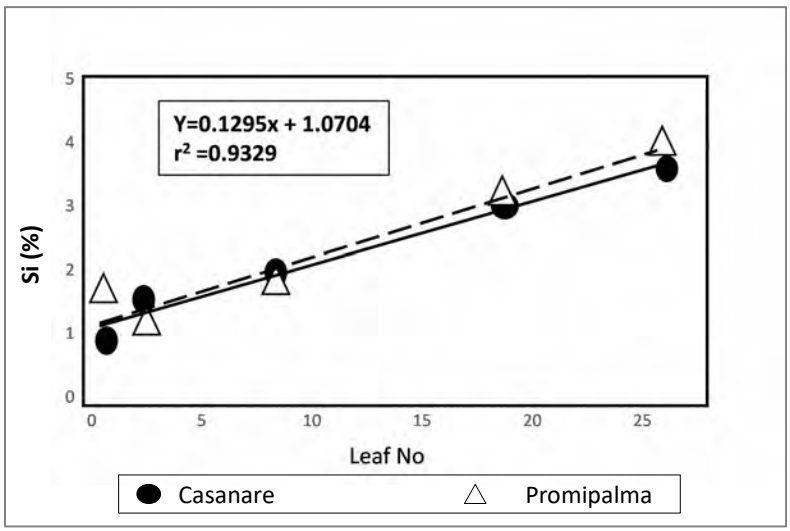


Fig. 3: Oil palm (Own foto).

Fig. 4: Silicon concentration within different leaf ages (number) **in two locations** (modified from MUNEVAR & ROMERO 2015).

2.6 Fire policy and institutions in Indonesia

The Indonesian government is well aware of the negative impacts of forest fire on the environment, e.g. on air quality, soil fertility, climate change, and biodiversity (EDWARDS & HEIDUK 2015). Hence, since 1984 land conversion through fire is prohibited by fines and prison terms (KETTERINGS ET AL. 1999; WORLD BANK 2016). Moreover, in the aftermath of increased fire frequencies in the 1980s, the first national long-term strategic fire management plan was prepared in Indonesia and three long-term projects were initiated: the EU-Forest Fire Prevention and Control Project (FFPCP) in Southern Sumatra (1995-1998), the Integrated Forest Fire Management Project (IFFM) in East Kalimantan (1994-2000) conducted by the German Agency for Technical Cooperation (GTZ), and the Forest Fire Prevention and Management Project (FFPMP) in Bogor, Jambi and West Kalimantan (1996-2001) directed by the Japanese International Cooperation Agency (JICA) (DENNIS 1999; GOLDAMMER ET AL. 2002). In addition, numerous short- and long-term fire projects were proposed and started to cover many aspects of fire problems such as socio-economic assessments, fire-fighting economic and policy assessments (DENNIS 1999). Additionally, Indonesia is a member of several regional and international conventions, such as the ASEAN Agreement on Transboundary Haze Pollution in Southeast Asia, Convention on Biological Diversity (CBD) and the UN Framework Convention on Climate Change (UNFCCC) (HERAWATI & SANTOSO 2011). In 1995, the National Centre for Forest Fire Control (Decree No. 188/ Kepts-II/1995) as well as the National Coordination Team for Land and Forest Fire Control (TKNPKHL) and a National Coordinating Team for Land Fire (TKNKL) (DecreeNo. Kep-18/MenLH/3/ 1995) (DENNIS 1999; GOLDAMMER ET AL. 2002) were established. The Indonesian government further instituted a number of legislative provisions concerning the problems of forest fire and established various institutions at national and local levels (HERAWATI & SANTOSO 2011). These legislations cover all necessary aspects of fire management (e. g. Act No. 18/2004), including integrated controlling of forest and land fires (Act No. 41/1999, Government Regulation No. 4/2001) and their negative impacts on the environment (HERAWATI & SANTOSO 2011). They prescribe provisions for forest exploitation and management; provisions pertaining to disaster management and decentralization processes (HERAWATI & SANTOSO 2011).

Despite the presence of these regulations, institutions and conventions to prevent and control forest fires, widespread forest fires in Indonesia continue to occur (EDWARDS & HEIDUK 2015). This raises questions about the adequacy and

effectiveness of these institutional mechanisms. According to EDWARDS & HEIDUK (2015) it is, among other reasons, the consequence of Indonesia's decentralization process whereby a (parcial) transfer of power from the national to the provincial and district levels occurred. As a result, the number of actors involved in the policy process multiplied and created overlapping at times contradictory jurisdictions which resulted in a confused and often contested decision-making process (EDWARDS & HEIDUK 2015). Additionally, laws are not enforced enough since many fires are difficult to monitor and police (DENNIS 1999). Fires often arise in remote and inaccessible areas. In particular, fire management practices by smallholders are problematic ignition sources. These are more dispersed than those of companies and therefore more difficult to monitor, resulting in legislated changes to burning practices being virtually impossible to enforce (DENNIS 1999). Smallholders mostly benefit through the expansion of oil palm plantations and their higher economic value (MURDIYARSO ET AL. 2002; RIST ET AL. 2010; EULER ET AL. 2015) and it proves to be a big challenge to implement responsible farming practices while improving their livelihoods (UNDP 2015). KETTERINGS ET AL. (1999) concluded that farmers will not likely adopt alternatives, if they only address the environmental problems associated with fire management practices and imply a decrease in yield, increase in risk of crop failure, and/or increase in labor and capital investment. Consequently, banning fire is no solution, while there is no viable alternative or any compensation for the benefits associated with the use of fire (KETTERINGS ET AL. 1999). Hence, many of the fires are illegally ignited, and it is unlikely that legislative means will be successful in dealing with these sources of ignition (TACCONI 2003). EDWARDS & HEIDUK (2015) concluded that to achieve success instead of just regulating the fire frequency by legislations and institutions there also should be a change in policy with regard to palm oil production. However, to achieve a reduction in forest fires parallel to the government target of an annual growth in palm oil production of 7 % seems questionable (EDWARDS & HEIDUK 2015).

2.7 Aims and hypotheses

Until there are more efficient solutions regarding fire management practices, it can be expected that land-use change by means of fire will continue to prevail as well as the associated negative effects to the environment. Therefore, numerus findings on both, effects due to land-use change as well as the effects of fire on soil properties are available in the literature. Further the Si-cycle is increasingly

being recognized as important part of nutrient cycling between soils and crops. CONLEY ET AL. (2008) showed that DSi in soil increases immediately after deforestation, but in the long-term, STRUYF ET AL. (2010) showed a decrease of overall DSi fluxes from cultivated land.

Nevertheless, specific studies concerning the impact of fires on Si-cycling in soils are lacking. The majority of studies investigate the consequences of land-use change from rainforest towards plantation as well as effects of fire on soil nutrient cycle, including effects mainly on essential nutrients (e. g. ALLEN 2015, KURNIWAN ET AL. 2018, BADÍA ET AL. 2014; RAISON ET AL. 2009; NEARY ET AL. 2005; FRANCOS ET AL. 2018) or on the CO_2-cycle (e. g. HASSLER ET. AL 2015). Regarding Si, studies focus nearly exclusively on weathering, the oceanic Si-cycle, or Si-plant interactions (e. g. ALEXANDRE ET AL. 1997; MEUNIER ET AL. 1999; CORNELIS ET AL. 2010; COOKE & DEGABRIEL 2016). So far, only a few studies of changes in Si availability due to fire management practices have been documented in the literature. NGUYEN ET AL. (2014) measured the soluble Si content up to 46 % of total Si content in rice straw ashes, thereby indicating that burning a Si-accumulator makes Si increasingly available. Confirming, UNZUÉ-BELMONTE ET AL. (2016) showed that BSi of organic soil material will be more susceptible to dissolution after burning.

Nonetheless, since oil palms are considered to be Si-accumulators there is a need to specifically investigate the influence of fire on the Si-cycle under oil palm cultivation. Since it is already known in the literature that fire increases the solubility of Si due to increased pH (but the pH increase is transient) the question remains whether the solubility of Si is affected by other fire-related factors or decreases again when the pH of the soil returns to the pre-fire value.

Therefore, the focus of this thesis was to determine the impacts of land-use conversion through fire management practices on Si availability. For this purpose pH independent Si dissolution of topsoil and litter from oil palm plantations were compared to those of rainforest in the humid-tropical climate of Sumatra, Indonesia, as well as the effect of different fire treatments on the Si availability of both materials.

Hypotheses:

H1: The impact of fire leads to increased Si release from topsoil and litter.

H2: Since oil palm plantations are expected to have undergone several fire events with subsequently increased Si release and leaching in wet climate, oil palm plantations have less soluble Si in soils than forests.

H3: Since oil palms are considered to be Si-accumulators, repeated fire events on oil palm plantations are followed by a higher Si-dissolution rate of oil palm plant litter compared to forest plant litter.

3. MATERIAL & METHODS

3.1 Field-work Permission

This study is associated to the German Research Foundation (DFG) funded Collaborative Research Centre (CRC) 990 “Impact of transformation of rainforests into oil-palm plantations on Si pools in soils” since March 2018 [https://www.uni-goettingen.de/de/310995.html, last access: 14.01.19]. The detailed description of the project, the experimental design and details of the soil management practices of the study sites are reported in detail in ALLEN ET AL. (2015) and HASSLER ET AL. (2016). Soil and litter sampling was conducted using the research permit 110/SIP/FRP/E5/Dit.KI/IV/2018 recommended by the Indonesian Institute of Sciences (LIPI) and issued by the Ministry of Forestry (PHKA).

3.2 Study Sites

The study was conducted in the Harapan landscape in the lowlands of Jambi province, in the south-western part of Sumatra, Indonesia (e. g. ALLEN 2015; DRESCHER ET AL. 2016) (Fig. 5). Two land-use types, lowland rainforest and smallholder monoculture plantations of oil palm, were selected in the Harapan landscape. Both land-use types are dominated by loamy Acrisols, which are heavily weathered soils with clay translocation characteristics. The humid tropical climate is characterized with two rainy seasons in March and December and a dry period in July and August (KOTTEK ET AL. 2006). The mean annual temperature is 26.7 ± 1.0 °C and mean annual precipitation is 2235 ± 385 mm [1991–2011; climate station at the Jambi Sultan Thaha airport of the Meteorological, Climatological and Geophysical Agency].

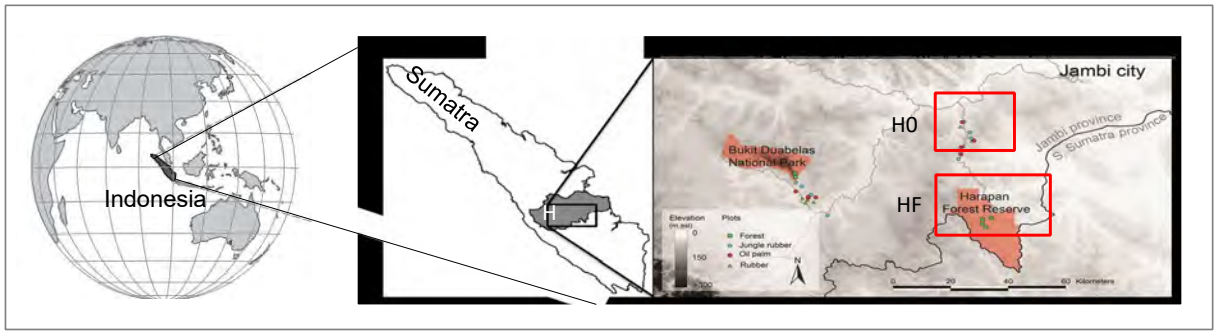


Fig. 5: Location of study area located in Jambi, Sumatra, Indonesia. The map on the right shows the CRC 990 core plots in the Harapan landscape (H), under rainforest (HF) and oil-palm plantation (HO) in loamy Acrisol soil landscape located south of Jambi city (modified from ALLEN ET AL. 2015 and DRESCHER ET AL. 2016).

Oil palm plantations are typically divided into oil palm row, inter-row and frond-pile (Fig. 6). In every second inter-row, old palm fronds are piled up. Plantation ages range from 9 to 16 years and the plantations are subject to common smallholder management practices (HASSLER 2016). According to interviews with smallholders, conducted by KURNIWAN ET AL. (2018), the selected oil palm plantations were established after clearing and burning the previous jungle rubber which in turn were previously lowland rainforests.

Study sites in the lowland rainforests were established within the protected Harapan Rainforest (PT. Restorasi Ekosistem Indonesia). The Harapan Rainforest is a former area of forestry which has been under protection since 2007 to restore and recover the ecosystem structure and biodiversity (WARDAH 2013). It is now managed by PT. Restorasi Ekosistem Indonesia (WARDAH 2013).

3.3 Soil and litter sampling

For this study, three oil palm plots were selected (Harapan oil palm, H02-4) of the CRC 990 core plots (Fig. 6: Management of oil palm plantations and positions (red dots) of topsoil (in inter-rows, n = 3) and litter (in frond-piles, n = 3) sampling.). Within the oil palm plots, three replicate topsoil samples in the inter-rows (n = 3, 0 – 1 cm) and three replicate samples of the organic litter layer below the frond-piles (n = 3) were taken (Fig. 6).

In the Harapan forest, three plots of the CRC 990 core plots were selected (HF2-4) and samples were taken in the destruction area of the plots (25 x 10 m, Fig. 7). Along the diagonal line of the destruction area at a distance of 6.7 m each, three replicate samples of the organic litter layer (n = 3) and the underlying topsoil (n = 3, 0-1 cm) were taken in an area of 20 cm x 20 cm (Fig. 7).

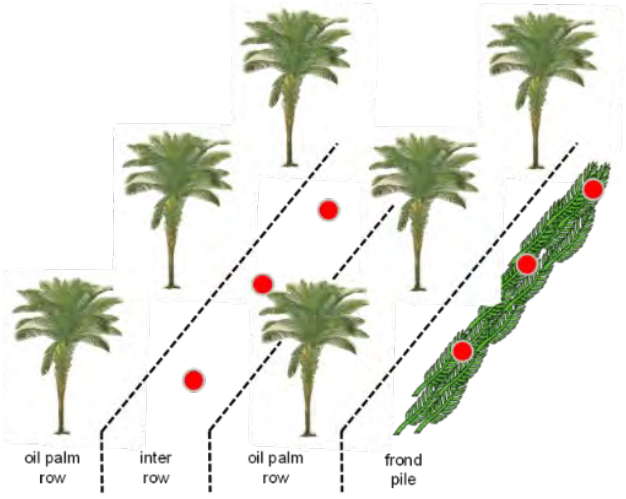


Fig. 6: Management of oil palm plantations and positions (red dots) **of topsoil** (in inter-rows, n = 3) **and litter** (in frond-piles, n = 3) **sampling.**

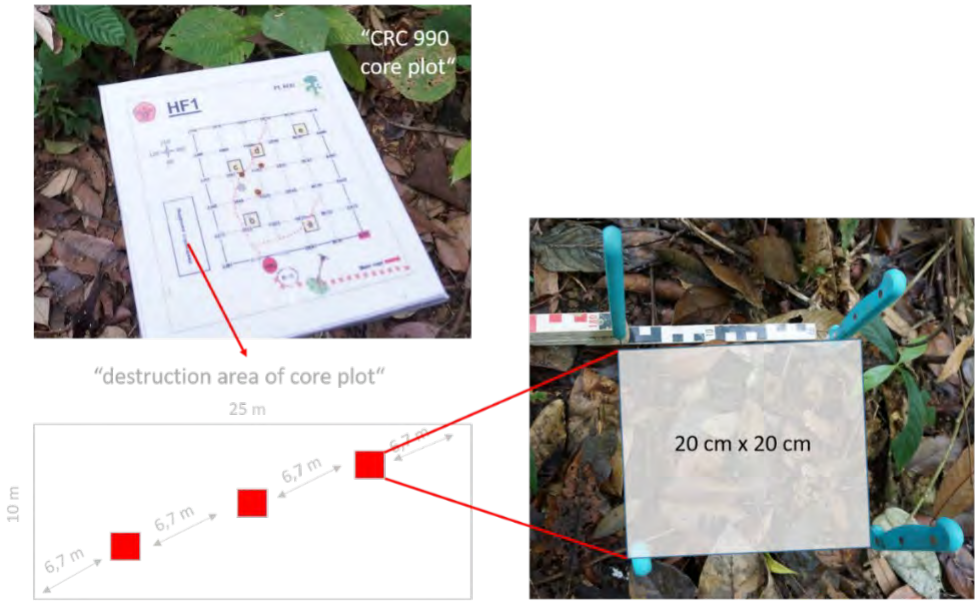


Fig. 7: CRC 990 forest core plots and positions (red squares) **of topsoil** (n = 3; 0-1 cm) **and litter** (n = 3) **sampling.**

3.4 Sample preparation

Topsoil samples were dried (24 h, 40°C) and sieved (≤ 2 mm). The litter samples were dried (24 h, 40 °C) and shredded with a plant mill.

Loss of ignition (LOI):

This method estimated soil organic matter (SOM) based on gravimetric weight change associated with high temperature oxidation of organic matter. Therefore 2-3 g topsoil and 1-2 g litter of oil palm plantations and forest were initial oven dried at 105 °C for 24 h, afterwards the samples were ignited in a muffle furnace for 5 hours at 430 °C (according to SCHLICHTING ET AL. 1995). The calculated percent weight loss between 105 °C dried and at 430 °C ignited samples is reported as OM-LOI (% wt. loss) with a method detection limit of 0.05 % (NELSON & SOMMERS 1996).

Calculation based on MAITI (2013):

$$\text{OM-LOI (\% wt. loss)} = \frac{(wt\,at\,105\,°C) - (wt\,at\,430\,°C)}{wt\,at\,105\,°C} \times 100$$

OM = organic matter; LOI = loss of ignition; wt =weight [g]

Fire–treatment

During a fire event, changes of soil chemical properties are often related to the degree and duration of soil heating (NEARY ET AL. 2005; FRANCOS ET AL. 2018). For the experiment two different fire-treatments were applied in order to simulate a moderate fire (300 °C = F1) (e. g. KETTERINGS & BIGHAM 2000; GLASS ET AL. 2008) and severe fire (500 °C = F2) with heavy fuels (e. g. fallen logs, tree trunks, tree stumps, surface litter, humus, roots) that are usually present due to land clearing and slash and burn practices (e. g. GLASS ET AL. 2008; CERTINI 2005; RAISON ET AL.2009). Various studies (e. g. CERTINI 2005; NEARY ET AL. 2005) indicate that the temperatures in a severe fire with heavy fuels rise above 500 °C, but RAISON ET AL. (2009) and BRADSTOCK & AULD (1995) point out that heat induced changes to soils would only affect the upper 1-2 cm and the maximum temperatures that can be reached in soil range from 140 °C to 500 °C. Therefore, only 0-1 cm of the topsoil were sampled and the maximum temperature was set at 500 °C.

For simulated burning, 6 g of soil and 0.5 g of litter was placed in a ceramic crucible. The crucible was placed in a preheated muffle furnance (300 °C and 500 °C) for 15 min (e. g. GLASS ET AL. 2008). After the simulated burnings, crucibles were cooled in a desiccator and residues were weighed.

3.5 Dissolution experiment

3.5.1 Simulated rainwater

A dissolution experiment with simulated rainwater was conducted to mimic natural conditions and natural reactivity of Si after burning. The preparation of the simulated rain water was adopted from KOCH (1986). The target values of the simulated rainwater and pH value correspond to the chemical characteristics of rainwater of Palembang, Sumatra, Indonesia during 2001–2010 (BUDIWATI ET AL. 2016) and are shown in Tab. 2. The calculated mean value of the pH is 5.4.

Tab. 2: Rainwater chemical characteristics (adopted from BUDIWATI ET AL. 2016)

Cations	**mg/L**
H^+	0.232
NH_4^+	1.209
Ca^{2+}	0.922

K^+	5.865
Mg^{2+}	2.187
Na^+	7.127
Anions	**mg/L**
NO_3^-	8.678
SO_4^{2-}	23.05
Cl^-	13.827

Stock solutions of chemicals (ACS reagent grade) and acids were prepared and mixed in order to fit the chemical rainwater characteristics of Palembang. Tab. 3 lists the chemicals used for the stock solutions and their concentrations. Tab. 4 lists the proportion of each of the stock solutions used for the simulated rainwater.

Tab. 3: Chemicals and their ion concentration in the stock solution.

Stock solution	Chemical	Concentration
1	KNO3	1 mg salt/g solution
2	NaCl	1 mg salt/g solution
3	$MgSO_4$ x $7H_2O$	1 mg salt/g solution
4	$(NH_4)_2SO_4$	1 mg salt/g solution
5	Na_2SO_4	1 mg salt/g solution
6	$CaCl_2$ x $2H_2O$	1 mg salt/g solution
7	KCl	1 mg salt/g solution

Tab. 4: Proportion of stock solution in simulated rainwater

Stock solution	Proportion [g/L]
1	15,2
2	11,4
3	22,2
4	4,4
5	8,1
6	3,4
7	4,8

3.5.2 Experimental design

For the dissolution experiment, 6 g soil and 0.5 g litter was mixed with 50 ml simulated rainwater in 50 ml polypropylene centrifuge tubes for litter and 120 ml tubes for soil. The dissolution experiment was carried out in a dark incubator on a

horizontal shaker (100 RPM) and samples were collected at 9 time intervals (5 and 30 min., and 1, 2, 5, 10, 21, 24 and 28 h). To control the results of the dissolution experiment, for each experiment a soil laboratory standard (HS) (Bt horizon of a Luvisol on loess; approx. 0.75% C, 18% clay; Hardegsen, Germany) was included, which was treated like the other samples.

It is already known in the literature that fire increases soil pH, thereby increasing the solubility of Si (NGUYEN ET AL. 2014). Since the increase in soil pH is usually temporary (NEARY ET AL. 2005) the dissolution experiment should be carried out pH independently. In order to investigate the influence of fire on Si solubility, without the influence of pH, the F1 and F2 sample-rainwater solutions were adjusted (0.1 M HCL) to the initial pH of the untreated samples (inoLab, Level 2, WTW, Weilheim, Germany).

At each time step, the samples were centrifuged, and an aliquot of 1 ml filtered (PES 0.45 µm, LABSOLUTE, TH Geyer, Renningen, Germany) and analyzed for DSi using a photospectrometer (UV VIS Spectrometer, Lamda 40, Perkin Elmer Instruments, Rodgau, Germany).

3.5.3 Photospectrometry analyses

In order to measure the Si contained in the topsoil and litter samples, reagents used in the analysis include a 4.5 M sulfuric acid solution (62.5 ml concentrated H_2SO_4 dissolved in 187.5 ml water), an acid molybdate solution (31.7 g ammonium heptamolybdate tetrahydrate ($(NH_4)_6Mo_7O_{24}$) dissolved in 250 ml water), an oxalic acid solution (10 g oxalic acid di-hydrate $(COOH)_2$ dissolved in 100 ml water) and an ascorbic acid solution (2.8 ascorbic acid ($C_6H_8O_6$) dissolved in 100 ml water). The acid molybdate solution was added to 250 ml 4.5 M sulfuric acid solution to prepare Mixed Reagent. The filtered aliquots (1 ml) of each time interval (5 and 30 min., and 1, 2, 5, 10, 21, 24 and 28 h) were diluted with deionized water (2.5 times (untreated samples) / 5 times (fire-treated samples)) and mixed with 100 µl Mixed Reagent. After 10 to 20 min., 100 µl oxalic acid solution and 50 µl ascorbic acid solution were added. After one hour the absorbance was measured at 810 nm with a 10 cm-path length cell.

To create a linear calibration, Si standards with known concentrations ranging from 0 ppm, 1 ppm, 2 ppm, 4 ppm, 6 ppm, 10 ppm, 20 ppm, 40 ppm were used to calculate Si dissolutions in the samples. HS were measured in the same matrix as the samples and measured at 810 nm with a 10 cm-path length cell.

3.5.4 Statistical Analysis

Si concentrations were measured repeatedly over 9 time intervals. Therefore a linear mixed effect (LME) model (according to CRAWLEY 2013) with temporal autocorrelation structure were used to assess the hypotheses. Land-use effects on Si release were tested including land-use types and time as fixed effect and plot-ID as random factor. Effects of fire on Si release were tested including treatments (untreated, F1 and F2) and time as fixed effect and plot-ID as random factor. Statistical analysis was conducted on the grand mean (n = 9) of the core plots (n = 3). A Tukey HSD post-hoc comparison was used to compare significant differences between single treatments. All differences were considered as significant at $p \leq 0.05$. Statistical analyses were conducted using R 3.0.2 (R DEVELOPMENT CORE TEAM 2013).

4. RESULTS

4.1 LOI

Results of the LOI measurements showed a general higher SOM content of forest topsoil and litter samples (**Tab. 5** & 6). The average LOI (n = 9) calculated for forest topsoils was 15.5 % wt. loss and 74.4 % wt. loss for forest litter. Whereas an average LOI (n = 9) for oil palm plantations topsoils and litter of 4.3 and 60.28 % wt. loss were measured, respectively.

Tab. 5: Loss of ignition (LOI) of oil palm plantations topsoil and litter samples.

Sample ID	Plot-ID	Sample material	Weight [g] (dried at 105°C)	Weight [g] (ignited at 430°C)	OM-LOI [% wt. loss]
H02_1	HO2	topsoil	17.9	17.7	3.7
H02_2	HO2	topsoil	15.1	15	3.6
H02_3	HO2	topsoil	17.9	17.8	3.2
H03_1	HO3	topsoil	16.3	16.2	4.8
H03_2	HO3	topsoil	16.1	16.0	3.3
H03_3	HO3	topsoil	21.1	21.7	2.6
H04_1	HO4	topsoil	16.1	15.9	7.4
H04_2	HO4	topsoil	15.4	15.2	6.7
H04_3	HO4	topsoil	21.8	21.7	3.9
H02_4	HO2	litter	20.8	20	42.6
H02_5	HO2	litter	21.4	20.7	33.0
H02_6	HO2	litter	21.4	20.8	30.4
H03_4	HO3	litter	21.1	20.1	69.7
H03_5	HO3	litter	23.1	21.8	66.0
H03_6	HO3	litter	15.0	14.2	60.0
H04_4	HO4	litter	18.8	17.7	87.2
H04_5	HO4	litter	13.1	11.8	73.4
H04_6	HO4	litter	19.7	18.4	80.3

Tab. 6: Loss of ignition (LOI) of forest topsoil and litter samples.

Sample-ID	Plot-ID	Sample material	Weight [g] (dried at 105°C)	Weight [g] (ignited at 430°C)	OM-LOI [% wt. loss]
HF2_1	HF2	topsoil	16.7	16.3	15.9
HF2_2	HF2	topsoil	16.6	16.2	13.5
HF2_3	HF2	topsoil	16.6	16.1	16.0
HF3_1	HF3	topsoil	16.9	16.7	10.9
HF3_2	HF3	topsoil	16.6	16.3	8.5
HF3_3	HF3	topsoil	15.6	15.4	10.1
HF4_1	HF4	topsoil	17.3	16.6	16.2
HF4_2	HF4	topsoil	17.1	16.5	20.7
HF4_3	HF4	topsoil	15.4	15.0	15.2
HF2_4	HF2	litter	15.1	14.1	62.6
HF2_5	HF2	litter	15.8	14.5	88.7
HF2_6	HF2	litter	15.3	14.1	74.2
HF3_4	HF3	litter	16.6	15.6	60.5
HF3_5	HF3	litter	15.4	14.4	59.8
HF3_6	HF3	litter	16.2	15.3	56.6
HF4_4	HF4	litter	15.7	14.3	89.9
HF4_5	HF4	litter	15.7	14.5	91.5
HF4_6	HF4	litter	16.1	14.8	86.0

4.2 Fire-treatment

F1 samples were characterized by incomplete combusted organic material (e. g. KETTERINGS & BIGHAM 2000), thereby the soil samples were reddish to yellow (e. g. NEARY ET AL. 2005) due to the oxidation of iron components (e. g. ERICKSON & WHITE 2008) and the litter samples were blackened (e. g. NEARY ET AL. 2005) (Fig. 8). After F2 the entire organic material was completely consumed, the soil samples were reddish and black (e. g. NEARY ET AL. 2005; ERICKSON & WHITE 2008; MERINO ET AL. 2018) and the litter samples were white ash (e. g. KETTERINGS & BIGHAM 2000) (Fig. 8). Due to a higher SOM content of forest topsoil samples (Guillaume, Kotowska), as confirmed by results of KOTOWSKA ET AL (2015) who showed a strong reduction in the biomass carbon pool (up to 166 Mg C ha^{-1}) on oil palm plantations compared to rainforests, as well as the respective LOI (15.451

% wt. loss for forest topsoils; 4.4 % wt. loss for oil palm plantation topsoils), forest samples were blackened with white ash when burned (Fig. 8).

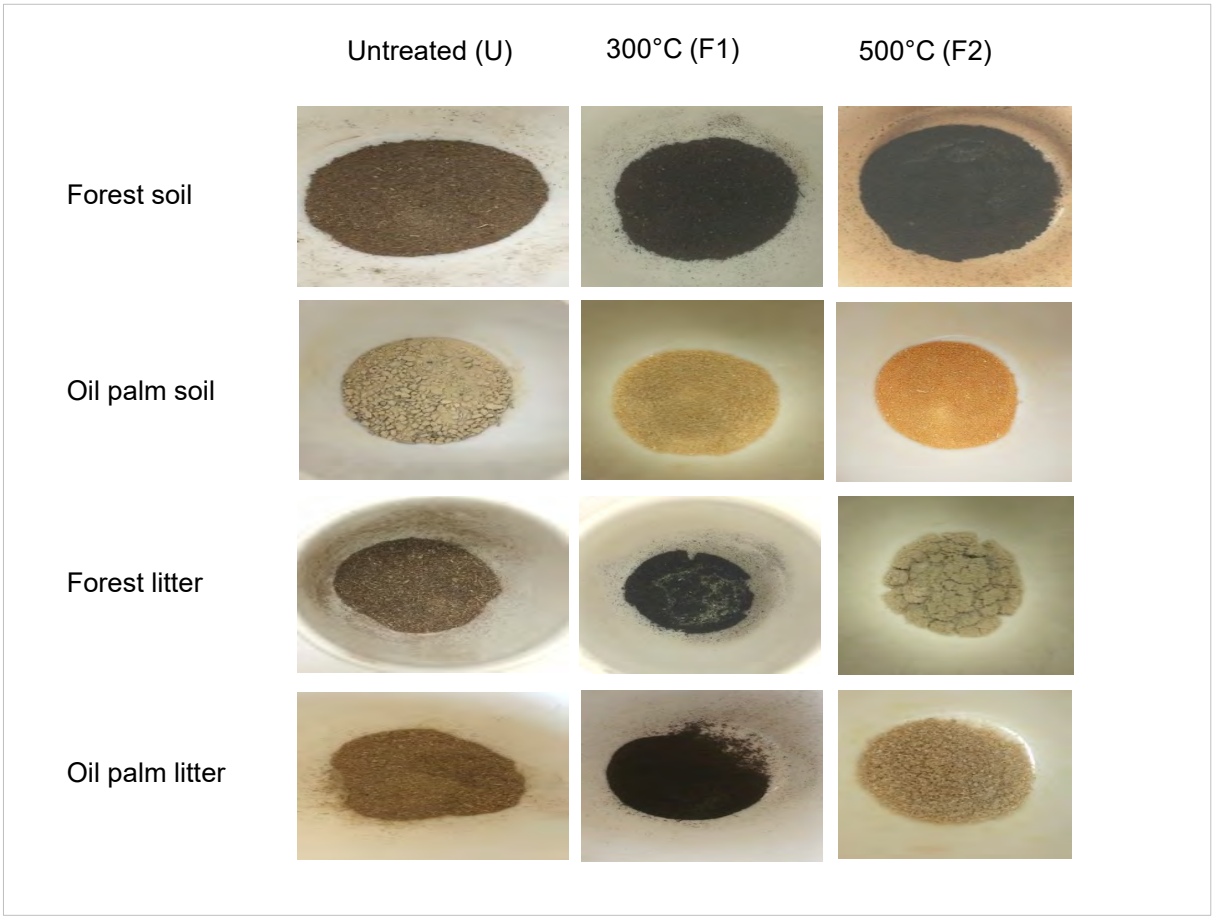


Fig. 8: Colour of topsoil and litter samples from oil palm plantations and lowland rainforest. The samples were untreated (U), fire-treated at 300 °C (F1) and fire-treated at 500 °C (F2).

4.3 Soil laboratory standard

The dissolution experiment with soil laboratory standards (HS) showed an increased Si release with increasing dissolution time and after F1 and F2 (Fig. 9). Untreated (U) HS showed a very low variability and differed significantly ($p \leq 0.05$) from the two fire-treatments (F1, F2). Although the two fire-treatments themselves showed no significant ($p \leq 0.05$) difference, due to a high variability, F2 samples displayed a generally higher Si release (Fig. 9). Within the dissolution experiment, total dissolved Si raised from 2.25 ± 1.23 µg g^{-1} to 13.77± 1.03 µg g^{-1} (U), from 25.96 ± 5.21 µg g^{-1} to 41.92 ± 8.89 µg g^{-1} (F1), and from 40.37 ± 18.43 µg g^{-1} to 60.32 ± 33.54 µg g^{-1} (F2) after 28 h.

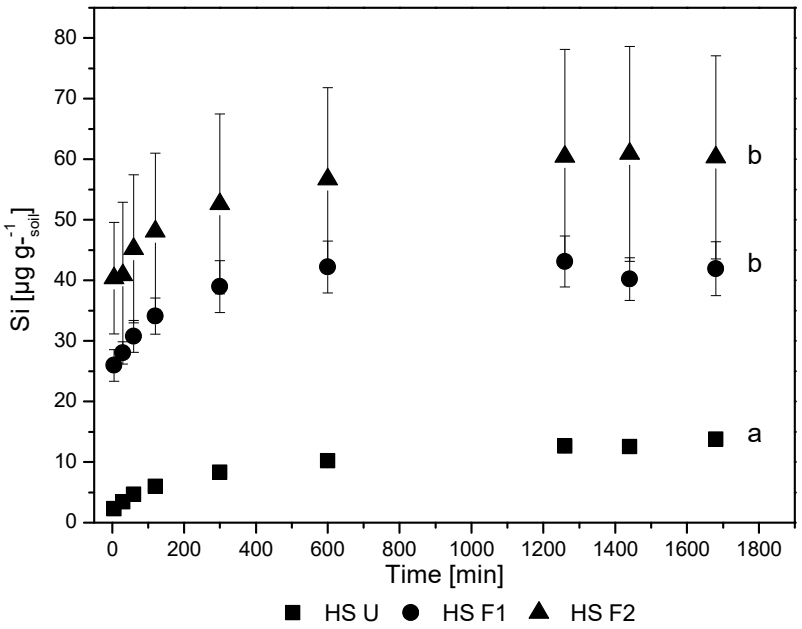


Fig. 9: Silicon release from soil laboratory standards (HS) during dissolution experiments in simulated rainwater. Si release measured at 9 different time intervals. Comparison between the different treatments (untreated (U), fire-treated at 300°C (F1) and fire-treated at 500°C (F2)) using the mean (± SE, n = 4). Different letters indicate significant differences between treatments (LME model with repeated measurement ANOVA at $p \leq 0.05$ and attached Tukey HSD post-hoc test at confidence level 0.95).

4.4 Control of pH value

The pH value displayed an increase in pH in both, oil palm plantations and forest samples, due to F1 and F2 treatments (Tab. 7). The pH value of the oil palm plantations topsoil samples increased slightly from 4.7 (U) to 5 (F1) and 5.2 (F2) on average. The pH value of the oil palm litter samples increased much stronger from an average of 5.8 (U) to 8.5 (F1) and 10 (F2). The pH value of forest samples showed a similar increase, but pH values were marginally lower compared to the oil palm plantations (Tab. 7). The pH value of forest topsoil samples increased on average from 3.7 (U) to 4.7 (F1) and 4.9 (F2). The average pH value of the forest litter samples increased from 6.5 (U) to 7.5 (F1) and 8.9 (F2).

Tab. 7: Mean pH values of topsoil and litter samples of oil palm plantations (n = 3; H02-04) **and forest** (n = 3; HF2- 4). The samples were untreated (U), fire-treated at 300 °C (F1) and fire-treated at 500 °C (F2).

Plot-ID	sample material	pH (U)	pH (F1)	pH (F2)
H02	topsoil	4.6	4.8	5
H03	topsoil	4.8	5.5	5.3
H04	topsoil	4.7	4.9	5.2
H02	litter	5.2	8.3	7.5
H03	litter	6.3	8.3	10.3
H04	litter	5.8	8.9	10.4
HF2	topsoil	3.7	4.8	4.9
HF3	topsoil	3.7	4.7	4.8
HF4	topsoil	3.7	4.6	4.9
HF2	litter	6.8	8.3	9.7
HF3	litter	5.9	6	7.8
HF4	litter	6.9	8.2	9.3

To control the pH values due to the dissolution experiment in simulated rainwater the pH of untreated (U) and F2 / adjusted with 0.1 M HCL oil palm topsoil subsamples (n = 6) (Fig.10) and forest litter subsamples (n = 9) (Fig. 11) were measured before and directly after (28 h) the dissolution experiment.

The pH values of oil palm topsoils (n = 6) showed in general only a few differences between the untreated and the fire-treated (F2) subsamples (Fig. 10). Untreated topsoil samples showed an average pH value of 4.4 before the dissolution experiment and 4.6 after 28 h. For F2 treated and adjusted topsoil samples an average pH of 4.7 was detected before the dissolution experiment and pH 5.1 after 28 h dissolution.

The pH of untreated forest litter showed barely changes through the dissolution experiment (Fig. 11). Before the experiment an average pH value of 4.8 was measured and 4.7 after the experiment (28 h). However, within the dissolution experiment of F2 treated forest litter the pH value tended to be higher after the experiment (Fig. 11). Average pH value before the experiment was 4.7 compared to 6.5 after the experiment (28 h).

Besides, all measured pH values were ≤ 7, with the exception of one subsample (HF4_4) that reached a pH value of 7.3 after 28 h dissolution, despite the adjustment with 0.1 M HCL.

Comparing the Si released during the dissolution experiments between pH adjusted and not adjusted F2 oil palm litter samples showed consistently higher Si release for litter samples without adjustment (Fig. 12). Although this trend was not statistically significant ($p \leq 0.05$), due to a high variation, the effect of pH on Si solubility was detectable. The average pH value of the pH adjusted litter samples was 6.2, whereas litter samples without adjustment showed an average pH value of 10.2 (Fig. 12). The Si release of pH adjusted litter samples raised from 1722 ± 1190.7 µg g^{-1} to 1736.44 ± 1951.74 µg g^{-1} after 28 h. Si released from litter samples without pH adjustment raised from 4774.85 ± 1798.22 µg g^{-1} to 4952.4 ± 2621.18 µg g^{-1} after 28 h.

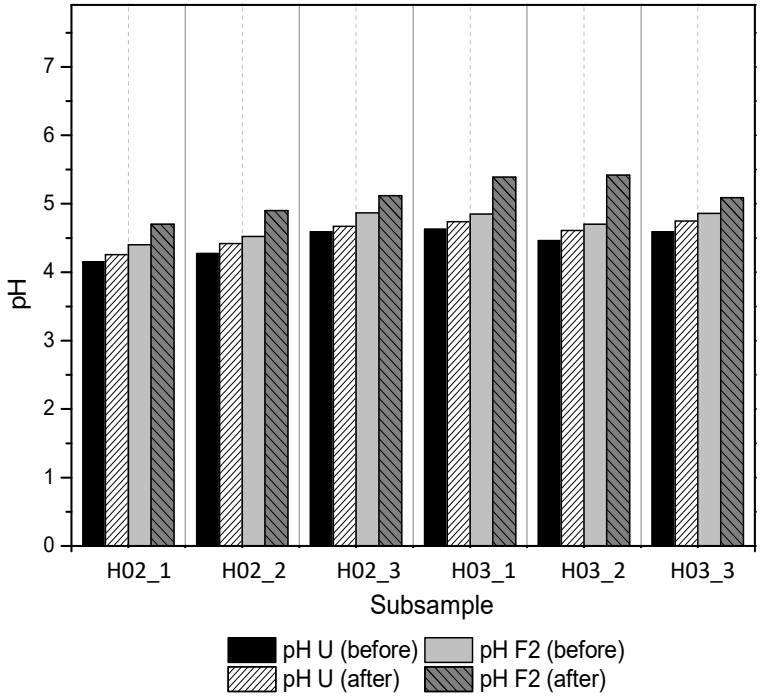


Fig. 10: PH values of oil palm plantations topsoil samples (n = 6; H02–H03). Comparison between pH values of untreated (U) and fire-treated at 500 °C (F2; adjusted with 0.1 M HCL) sampl**es,** measured before (before) and directly after (after) the dissolution experiment in simulated rainwater (28 h). The dissolution experiment was carried out in a dark incubator on a horizontal shaker (100 RPM). The adjusted F2 sample-rainwater solutions were adjusted to the initial pH of the untreated samples.

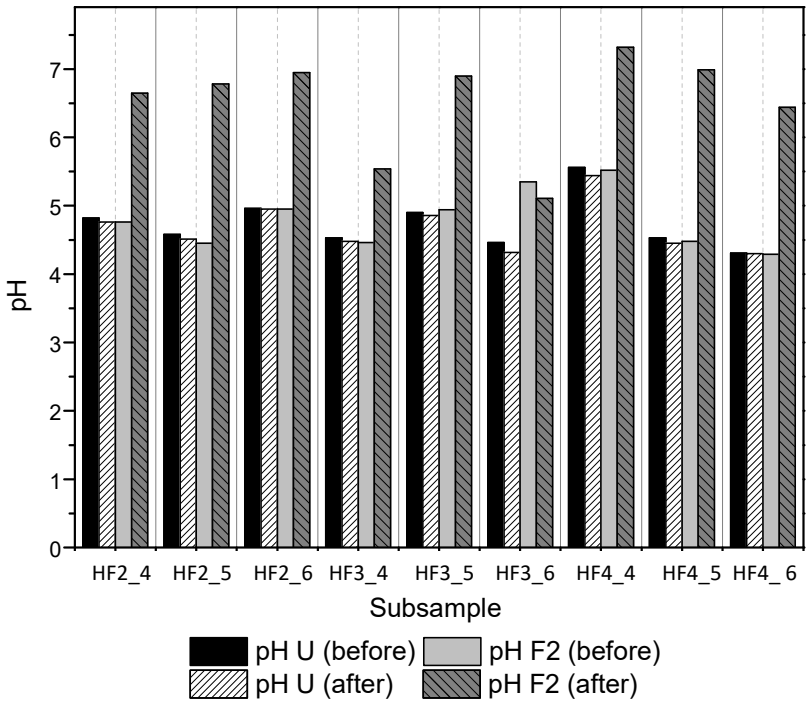


Fig. 11: PH values of forest litter samples (n = 9; HF2–HF4). Comparison between pH values of untreated (U) and fire-treated at 500 °C (F2; adjusted with 0.1 M HCL) samples, measured before (before) and directly after (after) the dissolution experiment in simulated rainwater (28 h).The dissolution experiment was carried out in a dark incubator on a horizontal shaker (100 RPM). The adjusted F2 sample-rainwater solutions were adjusted to the initial pH of the untreated samples.

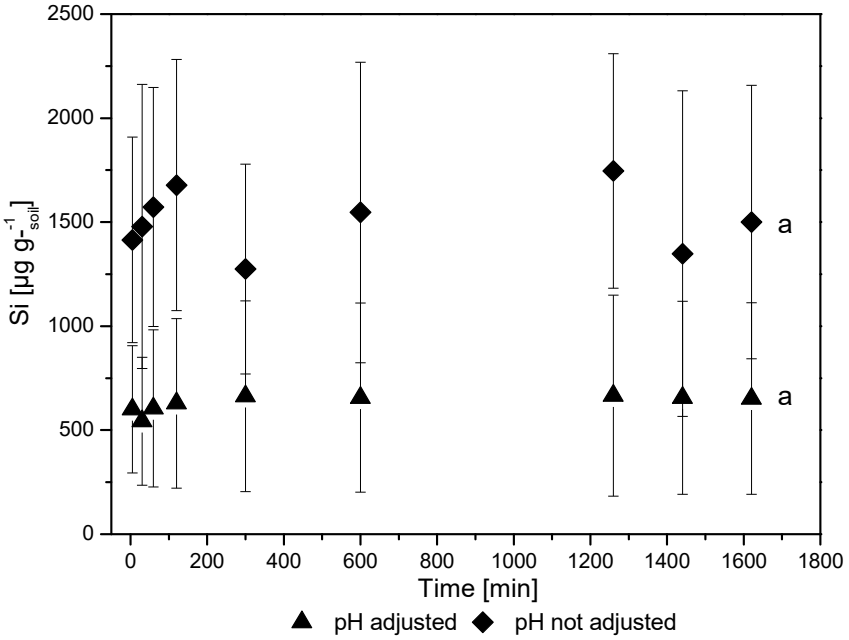


Fig. 12: Comparison of Silicon (Si) release from pH adjusted (with 0.1 M HCL) and not adjusted oil palm plantations topsoils [H02-4]. Si released from fire-treated at 500 °C (F2) loamy Acrisol topsoils (0-1 cm) during dissolution experiments in simulated rainwater. Dissolution experiments were carried out in a dark incubator on a horizontal shaker (100 RPM). Si dissolutions were measured at 9 different time intervals (5 and 30 min., and 1, 2, 5, 10, 21, 24 and 28 h) and compared using the grand mean of the core plots (± SE, n = 9). Different letters indicate significant differences between pH value (LME model with repeated measurement ANOVA at $p \leq 0.05$ and attached Tukey HSD post-hoc test at confidence level 0.95).

4.5 Effect of fire on silicon availability in topsoil and litter from rainforest and oil palm plantations

The dissolution experiments in simulated rainwater showed clear differences between sample material, land-use and fire-treatments. In general, litter samples showed higher Si dissolutions than topsoil samples. Thereby, Si released from forest topsoils were higher than from oil palm plantations topsoils (Fig. 13). Whereas oil palm litter samples showed a generally higher Si release than forest litter (Fig. 14). Although no significant differences ($p \leq 0.05$) were found between F1 and F2, the dissolution experiments showed an increased Si release with increased fire-temperature.

Si release of untreated oil palm plantations and forest topsoil and litter samples

The results of untreated topsoil samples of both land-use types showed a significant ($p \leq 0.05$) higher Si release from untreated forest topsoils (Fig. 13). The dissolved Si extracted from untreated oil palm plantation topsoils raised from 0.4 ± 0.2 µg g^{-1} to 8.05 ± 1.5 µg g^{-1} after 28 h. The dissolved Si from untreated forest topsoil samples raised from 3.15 ± 0.5 µg g^{-1} to 20.43 ± 2.8 µg g^{-1} after 28 h.

An inverse situation was shown by the results of untreated litter samples (Fig. 14). Although the results are not statistically significant ($p \leq 0.05$), oil palm litter samples generally revealed higher Si dissolutions during the dissolution experiments compared to forest litter. Dissolved Si of untreated oil palm litter raised from 7.7 ± 3.5 µg g^{-1} to 45.7 ± 13.7 µg g^{-1} after 28 h. The dissolved Si extracted from untreated forest litter raised from 5.3 ± 4.6 µg g^{-1} to 32.2 ± 7.5 µg g^{-1} after 28 h.

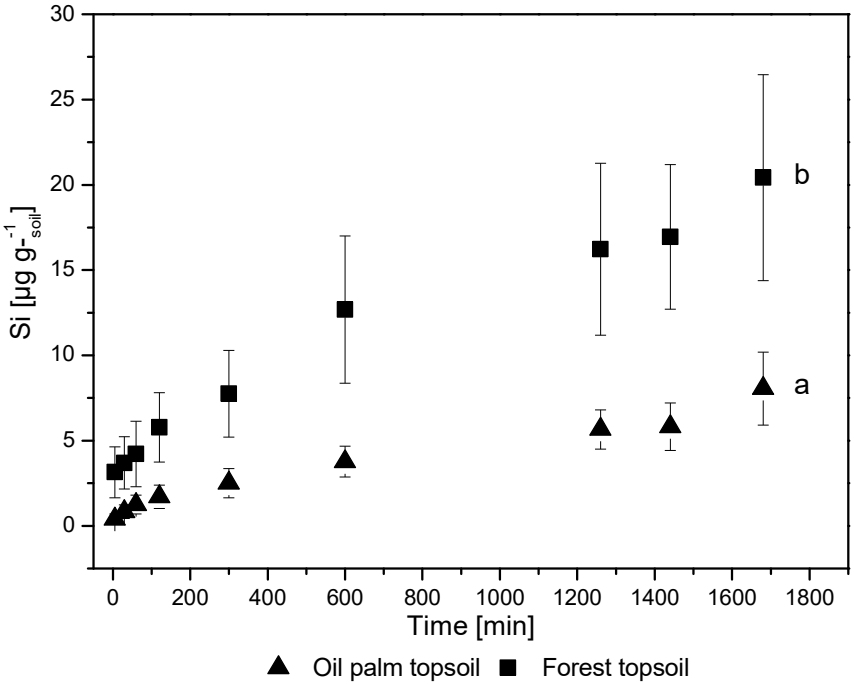


Fig. 13: Comparison of Silicon (Si) release from untreated oil palm plantations [HO2-4] and forest [HF2-4] topsoils. Si released from untreated loamy Acrisol topsoils (0-1 cm) during dissolution experiments in simulated rainwater. Dissolution experiments were carried out in a dark incubator on a horizontal shaker (100 RPM). Si dissolutions were measured at 9 different time intervals (5 and 30 min., and 1, 2, 5, 10, 21, 24 and 28 h) and compared using the grand mean of the core plots (± SE, n = 9). Different letters indicate significant differences between land-use (LME model with repeated measurement ANOVA at $p \leq 0.05$ and attached Tukey HSD post-hoc test at confidence level 0.95

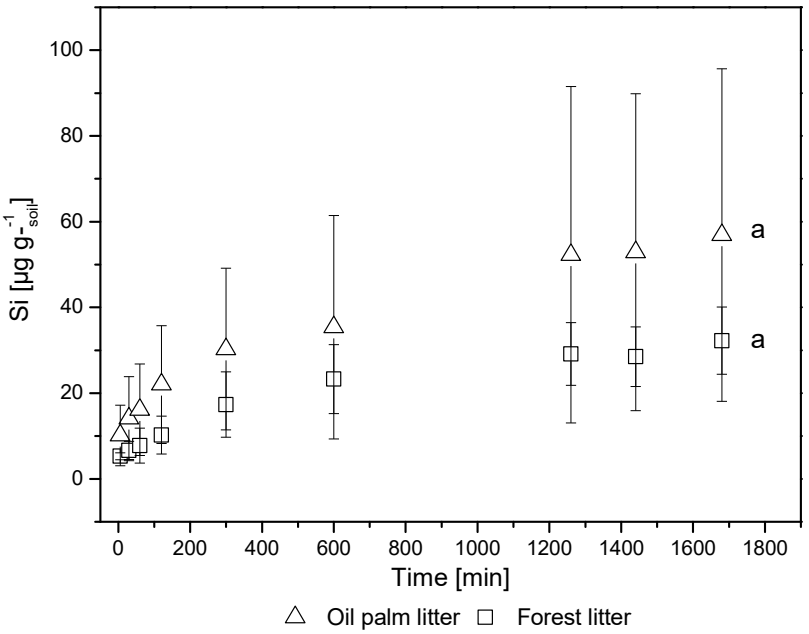


Fig. 14: Comparison of Silicon (Si) release from untreated oil palm plantations [HO2-4] and forest [HF2-4] litter. Si released from untreated litter during dissolution experiments in simulated rainwater. Dissolution experiments were carried out in a dark incubator on a horizontal shaker (100 RPM). Si dissolutions were measured at 9 different time intervals (5 and 30 min., and 1, 2, 5, 10, 21, 24 and 28 h) and compared using the grand mean of the core plots (± SE, n = 9). Different letters indicate significant differences between land-use (LME model with repeated measurement ANOVA at $p \leq 0.05$ and attached Tukey HSD post-hoc test at confidence level 0.95).

Si release of fire-treated topsoils and litter from oil palm plantations

The dissolution experiments showed a rapid release of dissolved Si with increasing dissolution time and after both fire-treatments (Tab. 8). Although the comparison between untreated (U) and fire-treated at 300 °C (F1) samples showed only significant differences ($p \leq 0.05$) within oil palm plantations topsoil samples, F1 treated litter samples generally showed a higher Si release than untreated (U) litter samples (Fig. 15 & 16). There were no significant differences ($p \leq 0.05$) between U and F1 samples detectable due to the variation in Si release within the replicates and plots (Tab. 8). In both sample material types, however, significant differences ($p \leq 0.05$) between untreated (U) and F2 treated samples were detected. While no significant differences ($p \leq 0.05$) were found between F1 and F2 samples, F2 samples showed an overall higher Si release than F1 samples.

The Si release of oil palm plantations topsoil samples raised from 0.4 ± 0.2 µg g^{-1} to 8.05 ± 1.5 µg g^{-1} for untreated samples (U), from 12.0 ± 2.6 µg g^{-1} to 35.2 ± 6 µg g^{-1} for F1 treated samples and from 23.1 ± 3.4 µg g^{-1} to 44.6 ± 5.9 µg g^{-1} within the dissolution experiments of F2 treated samples (Fig. 15). Si released from oil palm plantations litter changed from 7.7 ± 3.5 µg g^{-1} to 45.7 ± 13.7 µg g^{-1} (U), from 267.5 ± 93.7 µg g^{-1} to 456.1 ± 199.1 µg g^{-1} for F1 treated samples, and within F2 treated samples from 438.4 ± 123.8 µg g^{-1} to 396.5 ± 178.5 µg g^{-1} after 28 h (Fig. 16).

Si release of fire-treated topsoils and litter from lowland rainforest

Similar to the results of the oil palm plantations the fire-treatments led to an increased Si release within the forest samples (Fig. 17 & 18). The measured Si dissolution of the forest topsoil samples raised from 3.2 ± 0.5 µg g^{-1} to 20.4 ± 2.8 µg g^{-1} (U), from 34.6 ± 7.3 µg g^{-1} to 81.3 ± 12.6 µg g^{-1} (F1), and from 37.7 ± 2.0 µg g^{-1} to 64.8 ± 4.32 µg g^{-1} for F2 samples (Fig. 17). Thus, the untreated (U) topsoil samples differed significantly ($p \leq 0.05$) from F1 and F2 samples and increased with dissolution time.

Although a trend of higher Si dissolutions was detectable between untreated forest litter samples and the two fire treatments (F1, F2), a significant difference ($p \leq 0.05$) could only be detected between untreated (U) and fire-treated at 500 °C samples (F2) (Fig. 18) due to the variation in Si release among replicates and plots (Fig. 18; Tab. 6). No significant differences ($p \leq 0.05$) were found

between untreated and F1 treated samples, as well as between F1 and F2 treated samples ().

The total dissolved Si extracted for the forest litter samples increased from 5.3± 4.6 µg g^{-1} to 32.2 ± 7.5 µg g^{-1} (U), 182.2 ± 38.3 µg g^{-1} to 228.4 ± 62.0 µg g^{-1} for F1 treated samples, and from 240.4 ± 56.8 µg g^{-1} to 286.4 ± 82.7 for F2 samples (Fig. 18).

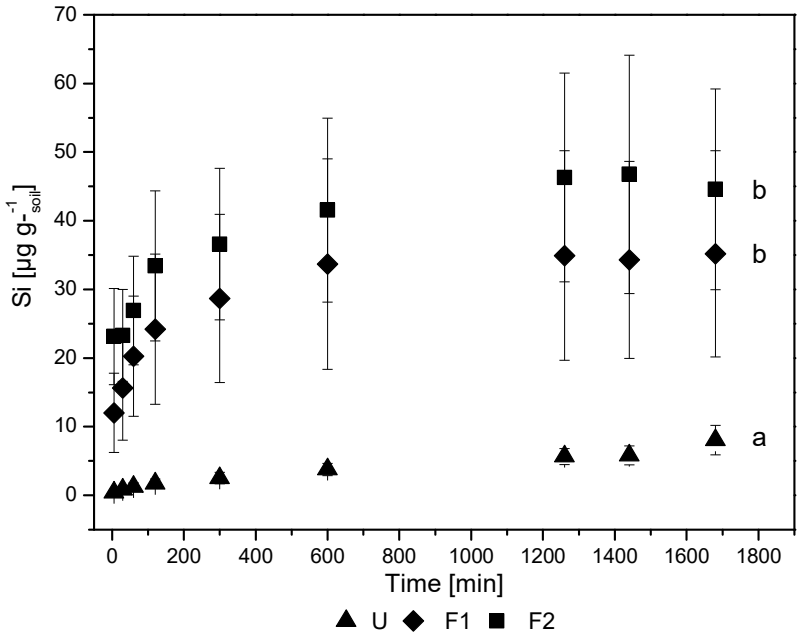


Fig. 15: Comparison of Silicon (Si) release from oil palm plantations [HO2-4] topsoils. Si released from untreated (U), fire-treated at 300 °C (F1) and fire-treated at 500 °C (F2) loamy Acrisol topsoils (0-1 cm) during dissolution experiments in simulated rainwater. Dissolution experiments were carried out in a dark incubator on a horizontal shaker (100 RPM). Si dissolutions were measured at 9 different time intervals (5 and 30 min., and 1, 2, 5, 10, 21, 24 and 28 h) and compared using the grand mean of the core plots (± SE, n = 9). Different letters indicate significant differences between treatments (LME model with repeated measurement ANOVA at $p \leq 0.05$ and attached Tukey HSD post-hoc test at confidence level 0.95).

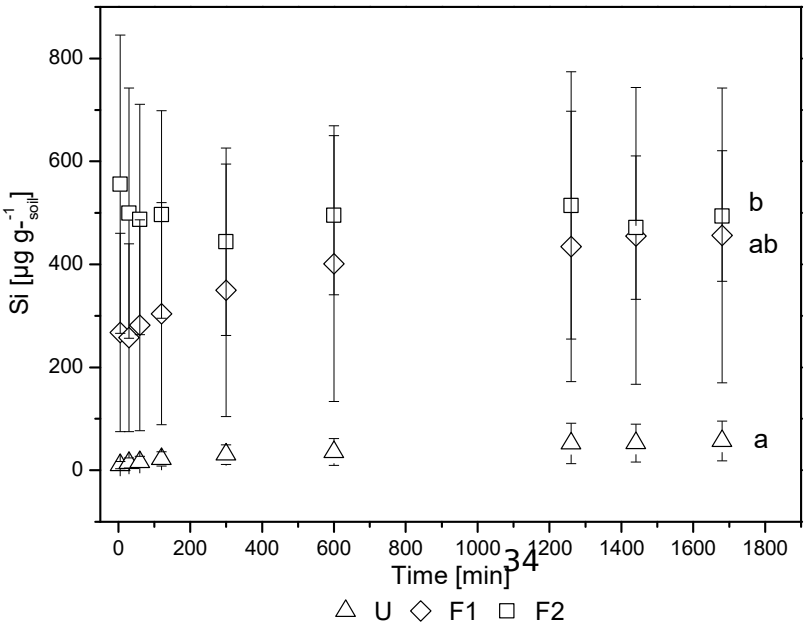


Fig. 16: Comparison of Silicon (Si) release from oil palm plantations [HO2-4] litter. Si released from untreated (U), fire-treated at 300 °C (F1) and fire-treated at 500 °C (F2) litter samples during dissolution experiments in simulated rainwater. Dissolution experiments were carried out in a dark incubator on a horizontal shaker (100 RPM). Si dissolutions were measured at 9 different time intervals (5 and 30 min., and 1, 2, 5, 10, 21, 24 and 28 h) and compared using the grand mean of the core plots (± SE, n = 9). Different letters indicate significant differences between treatments (LME model with repeated measurement ANOVA at $p \leq 0.05$ and attached Tukey HSD post-hoc test at confidence level 0.95).

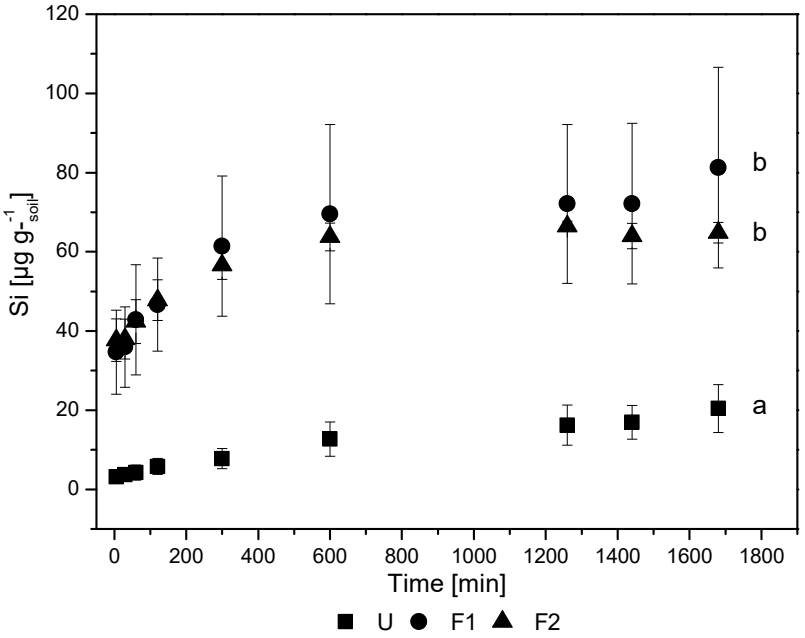


Fig.Fig. 17: Comparison of Silicon (Si) release from forest [HF2-4] topsoils. Si released from fire-treated at 300 °C (F1) and fire-treated at 500 °C (F2) loamy Acrisol topsoils (0-1 cm) during dissolution experiments in simulated rainwater. Dissolution experiments were carried out in a dark incubator on a horizontal shaker (100 RPM). Si dissolutions were measured at 9 different time intervals (5 and 30 min., and 1, 2, 5, 10, 21, 24 and 28 h) and compared using the grand mean of the core plots (± SE, n = 9). Different letters indicate significant differences between treatments (LME model with repeated measurement ANOVA at $p \leq 0.05$ and attached Tukey HSD post-hoc test at confidence level 0.95).

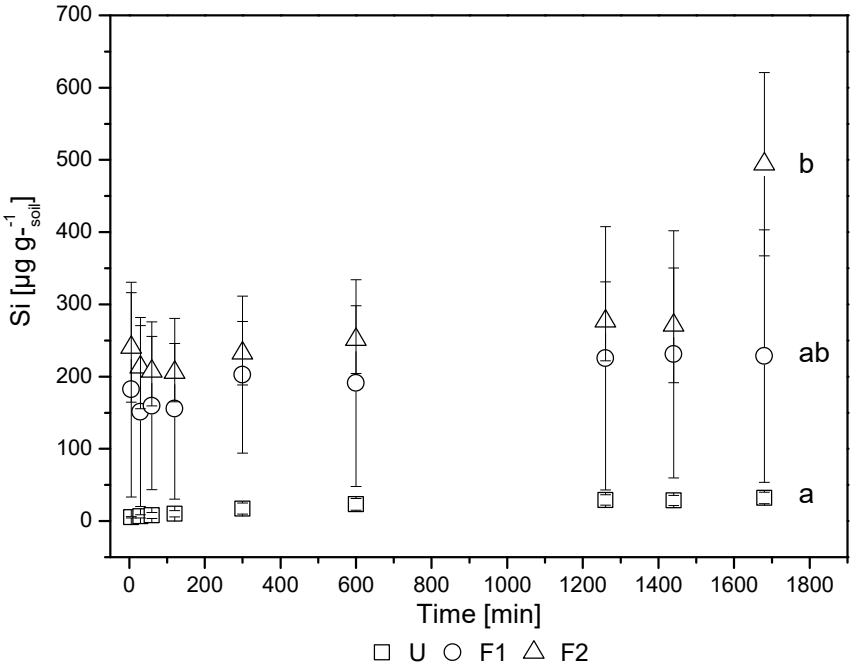


Fig. 18: Comparison of Silicon (Si) release from forest [HF2-4] litter. Si released from untreated (U), fire-treated at 300 °C (F1) and fire-treated at 500 °C (F2) litter during dissolution experiments in simulated rainwater. Dissolution experiments were carried out in a dark incubator on a horizontal shaker (100 RPM). Si dissolutions were measured at 9 different time intervals (5 and 30 min., and 1, 2, 5, 10, 21, 24 and 28 h) and compared using the grand mean of the core plots (± SE, n = 9). Different letters indicate significant differences between treatments (LME model with repeated measurement ANOVA at $p \leq 0.05$ and attached Tukey HSD post-hoc test at confidence level 0.95).

Tab. 8: Si release from oil palm plantations [H02-4] and forest [HF2-4] topsoils and litter. Si released from untreated (U), fire-treated at 300 °C (F1) and fire-treated at 500 °C (F2) litter samples during dissolution experiments in simulated rainwater. Dissolution experiments were carried out in a dark incubator on a horizontal shaker (100 RPM). Si dissolutions were measured at 9 different time intervals and compared using the grand mean of the core plots (± SE, n = 9).

Oil palm plantation [H02-H04]							
	Dissolution time [min]	topsoil (U)	topsoil (F1)	topsoil (F2)	litter (U)	litter (F1)	litter (F2)
Si [µg g-1 $_{soil}$]	5	0.4 ± 0.2	12.0 ± 2.6	23.1 ± 3.4	10.2 ± 10.4	267.5 ± 93.7	555.6 ± 157.7
	30	0.8 ± 0.3	15.6 ± 3.4	23.3 ± 3.4	14.1 ± 14.2	257.5± 98.8	499.4 ± 151.7
	60	1.2 ± 0.4	20.3 ± 3.7	26.9 ± 4.5	16.2 ± 13.7	281.8 ± 119.2	487.0 ± 145.0
	120	1.7 ± 0.5	24.2 ± 4.2	33.4 ± 6.1	22.0 ± 19.1	304.2 ± 137.8	496.9 ± 155.0
	300	2.5 ± 10.6	28.7 ± 4.9	36.6 ± 5.2	30.3 ± 22.3	349.7 ± 158.7	444.0 ± 172.5
	600	3.8 ± 0.9	33.7 ± 5.7	41.6 ± 6.2	35.4± 28.3	401.5 ± 178.4	495.4 ± 149.1
	1260	5.7 ± 1.1	35.0 ± 6.5	46.3 ± 6.2	52.3 ± 39.7	434.7 ± 185.4	514.4 ± 100.4
	1440	5.8 ± 1.1	34.3 ± 6.4	46.8 ± 5.6	52.9 ± 39.1	455.3 ± 195.0	471.2 ± 129.2
	1620	8.1 ± 1.5	35.2 ± 6.0	44.6 ± 5.9	56.9 ± 37.9	456.1 ± 199.1	494.0 ± 136.3
Lowland forest [HF2-HF4]							
Si dissolution	Dissolution time [min]	topsoil (U)	topsoil (F1)	topsoil (F2)	litter (U)	litter (F1)	litter (F2)
Si [µg g-1 $_{soil}$]	5	3.2 ± 0.5	34.6 ± 7.3	37.7 ± 2	5.3 ± 4.6	182.2 ± 38.3	240.4 ± 56.8
	30	3.7 ± 0.4	35.9 ± 5.2	38.0 ± 1.6	6.7 ± 4.4	151.2 ± 31.1	213.0 ± 48.5
	60	4.2 ± 0.6	42.8 ± 8.4	42.4 ± 1.8	7.8 ± 4.1	159.5 ± 37.9	207.5 ± 53.0
	120	5.8 ± 0.5	46.7 ± 6.2	47.8 ± 2.4	10.2 ± 4.9	155.4 ± 29.5	205.6 ± 52.4
	300	7.8 ± 1.0	61.4 ± 9.2	56.6 ± 3	17.4 ± 2.9	202.7 ± 68.6	232.4 ± 68.6
	600	12.7 ± 2.2	69.5± 8.7	63.7 ± 4.2	23.3 ± 6.0	191.0 ± 45.6	251.1 ± 73.5
	1260	16.2 ± 2.9	72.1 ± 8.7	66.4 ± 5.3	29.1 ± 8.2	225.3 ± 65.2	276.6 ± 81.0
	1440	16.9 ± 2.5	72.1 ± 8.7	64.0 ± 4.2	28.5 ± 8.9	230.8 ± 65.1	271.0 ± 81.6
	1620	20.4 ± 2.8	81.3 ± 12.6	64.8 ± 4.3	32.2 ± 7.5	228.4 ± 62.0	286.4 ± 82.7

5. INTERPRETATION

Testing the experimental design including sampling, dissolution experiments and photospectrometer measurements by HS and pH control yielded differences between untreated and fire-treated samples.

Statistical analysis showed overall very small standard errors (SE) of untreated HS (Fig. 9). Hence, sampling, quality of the simulated rainwater, the dissolution experiments itself and the photospectrometry measurements of the Si dissolutions seemed to have a consistent quality. However, Si release of fire-treated HS (Fig. 9) displayed high SE, a high variation between the individual Si dissolutions respectively. As a result, there was a trend recognizable between the individual fire-treatments (F1, F2), but no significant differences ($p \leq 0.05$) detectable (Fig. 9). Since the increased variation of the measured Si release of the fire-treated HS occurred primarily due to the fire-treatments, the differences could be a result of a non-homogeny fire-treatment. However, different Si release may be attributed to other reasons such as amount of phytoliths and morphotypes of Si.

As a result of the dissolution experiment in simulated rainwater, differences in pH were noted as well (Tab. 7). Results showed a higher content in basic cations in the topsoils and litter after burning (Tab. 7). These basic cations were released during combustion from residues, respectively ash, from burned biomass in the samples (NEARY ET AL. 2005; BODÍ ET AL. 2014; MERINO ET AL. 2018). The increase in soil pH is depending upon the original soil pH, amount of ash released and chemical composition of the ash (NEARY ET AL. 2005), however, is an important factor affecting the availability of plant nutrients (GIARDINA ET AL. 2000). There are numerous findings in literature which have shown that Si is most insoluble around pH 3 and that Si solubility increases significantly at pH > 7 and pH > 8 (ILER 1979; FRAYSSE ET AL. 2006; SOMMER ET AL. 2006; UTAMI ET AL. 2014; LI ET AL. 2017) (Fig. 19). For example FRAYSSE ET AL. (2006) observed a pH rise from 3.0 to 6.5 for dry ashed rice straw samples heated at 400 °C, which resulted in an increased Si release.

Besides, increasing Si release through pH increase is confirmed by the results of the pH measurements (Fig. 12). The comparison of F2 topsoil samples adjusted with 0.1 M HCL before the dissolution experiment compared to F2 topsoil samples

without adjustment revealed differences in Si release: the higher the pH, the higher the Si in solution (Fig. 12).

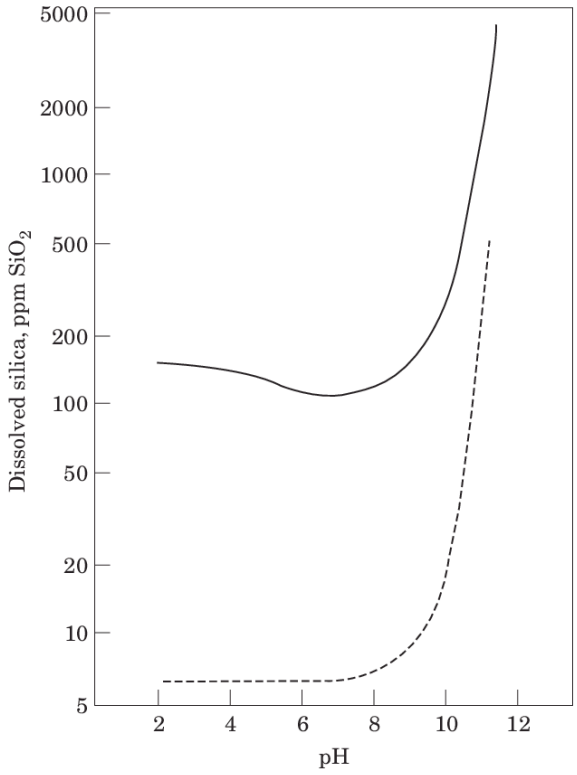


Fig. 19: Variation of solubility of Silica at 25 °C with pH. The solid line is the solubility of amorphous silica (opal); the dashed line is the calculated solubility of quartz (adapted from KARKANAS ET AL. 2000).

In order to exclude the effect of pH on Si solubility, the pH value was adjusted with 0.1 M HCL after the fire-treatments (F1, F2). Testing the method yielded different results for topsoil and litter samples (Fig. 10 & 11). The results of pH values measured before and after the dissolution experiment (28 h) showed barely differences within untreated oil palm topsoil samples compared to fire-treated (F2) and adjusted topsoil samples (Fig. 10). Hence, the adjustment with HCL seemed to be sufficient to keep the pH constant due to the experiment.

The comparison of pH values measured before and after the experiment (28 h) with untreated and fire-treated/adjusted (F2) forest litter samples showed no change within the untreated samples (Fig. 11). However, the pH of fire-treated litter samples increased during the experiment, despite the adjustment with HCl before the experiment (Fig. 11). The adjustment was insufficient to compensate the basic cations released during the experiment. Since the pH value has not risen above pH 7, except for one sample, the impact on amorphous Si is negligible (e. g. KARKANAS ET AL. 2000).

In summary, it can be assumed that the Si concentrations measured in the dissolution experiment were predominantly pH independent.

6. DISCUSSION

Si release from different sample material types

The dissolution experiments in simulated rainwater revealed overall higher rates of rainwater soluble Si within litter samples compared to topsoil samples (Fig. 13 & 14), especially within the experiments of F1 and F2 samples (Fig. 15, 16, 17 & 18). In general, the results fit well with the common literature.

Litter samples are originated of dead vegetation, in which Si is deposited as BSi mainly in form of phytoliths (ALEXANDRE ET AL. 1997; MA ET AL. 2001; SANGSTER ET AL. 2001). According to ALEXANDRE ET AL. (1997) the Si release from BSi can expected to be two to three times as great as that from silicate weathering. They showed about 74% of the DSi in soil solution of a Latosol in Congo originates from the dissolution of phytoliths. These results parallel the results of FRAYSSE ET AL. (2009) who showed that phytoliths extracted from different plants (larch, elm, fern, horsetail) are more soluble than clay minerals, primary mafic silicates, or feldspars. Thus, the litter samples generally contained more phytoliths than the topsoil samples, which have a high solubility compared to crystalline soil minerals and thereby significantly controlled the level of dissolved Si in the solutions.

Si release from different land-use types

By comparing Si dissolutions of untreated topsoil and litter samples significant *($p \leq 0.05$)* higher Si release were found in forest topsoils (Fig. 13). Whereas results of the dissolution experiments with litter samples showed a higher release of Si from oil palm plantations (Fig. 14). Although these results were not statistically significant ($p \leq 0.05$), a clear trend between oil palm plantations and forest was identifiable.

As explained above plant biomass contains large amounts of rainwater soluble Si (e. g. ALEXANDRE ET AL. 1997; MA ET AL. 2001; SANGSTER ET AL. 2001, FRAYSSE ET AL. 2009), hence differences in Si release of topsoils from forest and oil palm plantations (Fig. 13) could be attributed to the inherent amount of SOM. Supporting the assumption MARANGUIT ET AL. (2017) found that total organic P correlates strongly positively with C content, suggesting that SOM plays a key role in maintaining P availability. Same could be likely for Si, with higher Si release from forest soils indicating a higher inherent biomass content compared

to oil palm plantations topsoils. This would be directly or indirectly due to human activities on oil palm plantations.

The agricultural management practices associated with monoculture plantations (such as oil palm) increases the risk of topsoil erosion (e. g GHARIBREZA ET AL. 2013; GUILLAUME ET AL. 2015) and disrupted nutrient cycling by collecting the organic litter in frond-piles (e. g. GUILLAUME ET AL. 2016). As a result, there were only thin topsoil horizons in the inter-rows of the oil palm plantations (e. g. GUILLAUME ET AL. 2015; ALLEN ET AL. 2016). In contrast the forest core plots had a thick organic topsoil horizon, noticeable as mentioned by a higher LOI (Tab. 5 & 6) or soil color (Fig. 8). Confirming, KRASHEVSKA ET AL. (2015) have found a reduction in the amount of litter in oil palm plantations up to 84% compared to rainforests. Besides, GUILLAUME ET AL. (2015) detected a decrease in C content up to 70% in the Ah horizon under oil palm plantaion compared to forest. Whereas KOTOWSKA ET AL (2015) concluded that conversion of natural lowland rainforests into oil palm plantations leads to a strong reduction not only in the biomass carbon pool (up to 166 Mg C ha^{-1}) but also in the C sequestration via long-term biomass accumulation (biomass-C:NPP-C was 3–10 times higher in the natural forest).

In addition, the higher Si release of forest topsoil samples compared to oil palm plantations topsoils may due to a higher fluctuation of fire events on oil palm plantations. As shown by the results of the dissolution experiments within F1 and F2 topsoil and litter samples (Fig. 15, 16, 17 & 18) and the literature (e. g. CABANES ET AL. 2011; UNZUÉ-BELMONTE ET AL. 2016), fire leads to increase Si solubility. If a large part of Si can be more easily dissolved after burning, a high loss of Si from the ecosystem through subsequent precipitation is likely. Thus, the lower Si release within oil palm plantations topsoils (Fig. 13) can be attributed to an already occurred land conversion including fire management practices. Confirming, ALLEN ET AL (2015) measured a higher soil pH (4.2 ± 0.0–4.6 ± 0.1; $p \leq 0.04$) and base saturation (8.9 ± 1.6–6.5 ± 1.3%; $p \leq 0.07$) for the oil palm plantations core plots compared to the forest core plots. Since fire leads to increase soil pH (e. g. GIARDINA ET AL. 2000; NEARY ET AL. 2005) the results can suggested to be an indication for past slash and burn practices (MERINO ET AL. 2018).

Consequently, the conversion of natural lowland rainforest into oil palm plantations and their management substantially changes terrestrial Si-cycling

because Si is lost through fire practices and reconstitution of Si to soils in litter fall is prevented.

Differences that were observed within the Si dissolutions of litter samples from forest and oil palm plantations were not statistical significant *($p \leq 0.05$)* due to high SE of both types of land-use, which indicated a greater heterogeneity within the forest and oil palm plantations litter samples. Differences within oil palm litter samples may due to the varying plantation age, which ranged from 9-16 years (HASSLER 2016). While apparently the Si release from plant litter is independent of cellulose hydrolysis as shown by results of litter degradation of bamboos and horsetails by FRAYSSE ET AL. (2006), a number of recent studies concluded a dependency between phytolith age and dissolution rate, with increasing phytolith stability over time (CABANES ET AL. 2011; KLOTZBÜCHER 2016). Further, MUNEVAR & ROMERO (2015) showed an increasing storage of Si with increasing age of oil palm leaves.

Concerning the forest samples, it can be assumed that the higher plant diversity in the forest has resulted in varying forest field replicates regarding the occurring plant species and morphotypes (KRASHEVSKA ET AL. 2015). Higher plant species differ characteristically in their capacity to take up Si (MARSCHNER 2008) as well as in the ability to accumulate Si (0.1–10 % of shoot dry weight) (TAKAHASHI ET AL. 1990; HODSON ET AL. 2005; CURRIE & PERRY 2007; AHMAD & RASOOL 2014). VAN SOEST (2006) showed a variation in Si accumulation from 0.5 g kg^{-1} in polished rice, 50 g kg^{-1} in rice bran, 130 g kg^{-1} in rice straw, 230 g kg^{-1} in rice hulls to 350 g kg^{-1} in rice joints. Same applies for tropical tree species as shown by NAKAMURA ET AL. (2019) who measured substantially differing leaf Si concentrations (0.24 – 13.6 mg g^{-1}). In addition, there is a great variability of phytoliths in terms of their morphology and solubility (e. g. PIPERNO 2006). CABANES ET AL. (2011) showed that there are differences in the stability of phytolith morphotypes, which can lead to a different solubility. Thus, the heterogeneity of Si dissolutions is related to different amounts and solubilities of phytoliths, which resulted from different plant species, phytolith morphotypes and ages.

However, litter samples collected on oil palm plantations achieved generally higher Si dissolutions during the dissolution experiments in simulated rainwater compared to forest litter (Fig. 14), indicating a higher ability of oil palms to take up and accumulate Si (e. g. MA ET AL. 2001; LAW ET AL. 2007; MUNEVAR & ROMERO 2015). Confirming, PA ET AL. (2016) obtained about 46.0 % silicon element in palm ash and OOI ET AL. (2015) measured 33.95 mass-% SiO2 in the ash of empty

oil palm fruit bunches. Moreover MUNEVAR & ROMERO (2015) measured high Si concentrations for oil-palm fronds (on average 2.0 mass-%;), which classifies oil palms as Si accumulators according to the classification scheme of MA & TAKAHASHI (2002). Whereas NAKAMURA ET AL. (2019) reported only up to 1,36 mass-% leaf Si concentrations among tropical tree species from Mt. Kinabalu (Borneo) and ALEXANDRE ET AL. (1997) found a Si content in litterfall leaves of the rainforest in Mayombe Range (Congo) up to 1.5 ±0.15 mass-%. Hence, it can be assumed that oil palm litter samples have a higher content of Si compared to forest plant litter, which in turn leads to generally higher Si dissolutions (Fig. 14).

Si release through fire-treatments

The dissolution experiments clearly demonstrates that the solubility of Si in the topsoils and litter of forest and oil palm plantations increase after burning (Fig. 15, 16, 17 & 18). The results coincided with findings e. g. by XIAO ET AL. (2014), GUO & CHEN (2014) and UNZUÉ - BELMONTE ET AL. (2016) which showed increased Si solubility through burnings at temperatures of 350 - 500 °C. Although the results showed no significant *($p \leq 0.05$)* difference between the two fire-treatments (F1, F2), the highest degree of fire-treatment (F2) showed a generally higher Si dissolution in simulated rainwater compared to the other treatments (U, F1), except for the forest topsoil samples. Therefore a dependency between fire-temperature and Si release seems likely. This applies to temperatures up to 500 °C since burnings at temperatures > 500 °C crystallize amorphous Si (XIAO ET AL. 2014; UNZUÉ-BELMONTE ET AL. 2016), which seem to decrease Si solubility (UNZUÉ-BELMONTE ET AL. 2016).

Since the dissolution experiments were primarily pH independent, the increase in Si dissolution through fire-treatments is due to other processes. UNZUÉ-BELMONTE ET AL. (2016) conjectured that removing the organic matrix strongly increases the dissolution capacity of BSi, which might provide an explanation for the increased Si solubility from topsoils and litter after the fire-treatments (F1, F2). The combustion of topsoil and litter resulted in a loss of SOM, which increased the release of phytoliths that were accumulated as solid amorphous Si fraction in the biomass (e. g. SANGSTER ET AL. 2001; MA ET AL. 2001; ALEXANDRE ET AL. 1997). Besides, combustion of SOM increases the reactive surface area of Si compounds, leading to increased solubility (UNZUÉ- BELMONTE ET AL. 2016). Same applies for coated mineral surfaces by organic compounds (ILER 1979; POULENARD ET AL. 2004). Further, POULENARD ET AL. (2004) showed that after extraction of organic materials water contact-angles decreases strongly. A similar effect is likely for

the fire treatments, reducing the water repellency by burning the SOM could make the phytoliths more susceptible to dissolution. Confirming, the degree of hydrophobicity is positively correlated with the SOM content in soils (MATAIX-SOLERA & DOERR 2004; LEELAMANIE & KARUBE 2009; JIMÉNEZ-MORILLO ET AL. 2017). Laboratory studies showed that during burnings at temperatures of 175-270°C organic compounds with hydrophobic properties in the litter and topsoil can be volatized and condensed in the soil, inducing or intensifying water repellency (DOERR ET AL. 2009). In contrast, during burnings with high severity with temperatures above 270-400°C, water repellency is destroyed (DOERR ET AL. 2009).

Moreover, the dissolution of Si in water requires the presence of a catalyst, hydroxyl ions (OH^--ion) respectively (ILER 1979). On the surface of Si aggregates are gaps between oxygen ions that are large enough to absorb OH^- ions, whereby Si is constantly exchanged in equilibrium between the solution and the surface (ILER 1979). BAUMANN (1955) has shown that from pH 3 to about 6 the Si dissolution rate is strongly linked with the OH^--concentration. Heating BSi removes the hydroxyl groups and bound water (JONES AND SEGNIT, 1969), whereby the Si becomes apparently unstable and slightly more soluble (e. g. CABANES ET AL. 2011).

This implies that Si solubility through burning may be reflected by the amount of SOM, but also the amount of bound water and OH^-- ion in the Si might contribute to an increased Si dissolution after fire-treatments. Besides, the fire treatments associated with the combustion of SOM led to a Si release from litter, increased the reactive surface area and decreased the water repellency, whereby water could more easily access and dissolve BSi.

7. CONCLUSIONS

Due to the Indonesian government goal to double oil palm production by 2020 and fire used widely as a management tool for converting lowland rainforest into plantations the results have strong implications regarding Si availability on oil palm plantations.

In general, the results are consistent with current literature. Based on the implications above, Si solubility is influenced by factors such as SOM content, age and morphotypes of phytoliths as well as the amount of bound water and OH^--ions. Besides, a main factor affecting Si availability on oil palm plantations is due to the management practices of plantations. The agricultural management

practices associated with monoculture plantations increase the risk of topsoil erosion and prevent the reestablishment of Si in soils through litter fall. Besides, the conversion of natural lowland rainforest into oil palm plantations through fire practices makes Si more susceptible to solution.

Considering a large amount of Si accumulated in oil palms, along with increasing palm oil production and, as a result, land-use change through fire management practices, significant changes in the biogeochemical silica cycle can be assumed.

Further studies about Si biogeochemistry will help to better understand the effects of fire on terrestrial Si fluxes. Besides, since legislative means are not successful in dealing with illegal fire management practices, a general understanding of the considerable changes to site productivity and sustainability through fire has to be established within land managers and integrated to planation management concepts.

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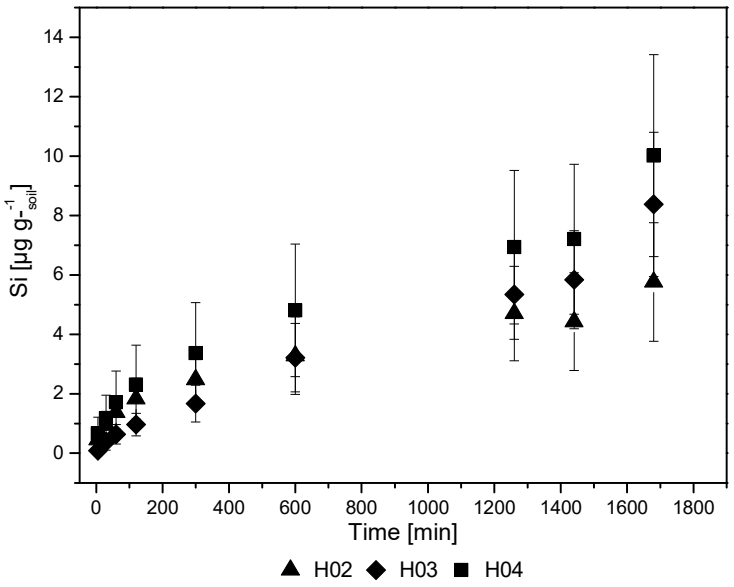
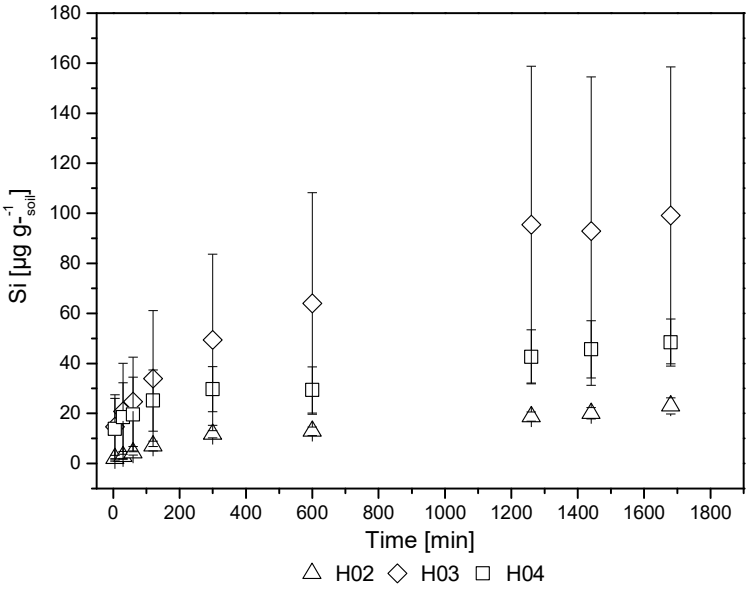
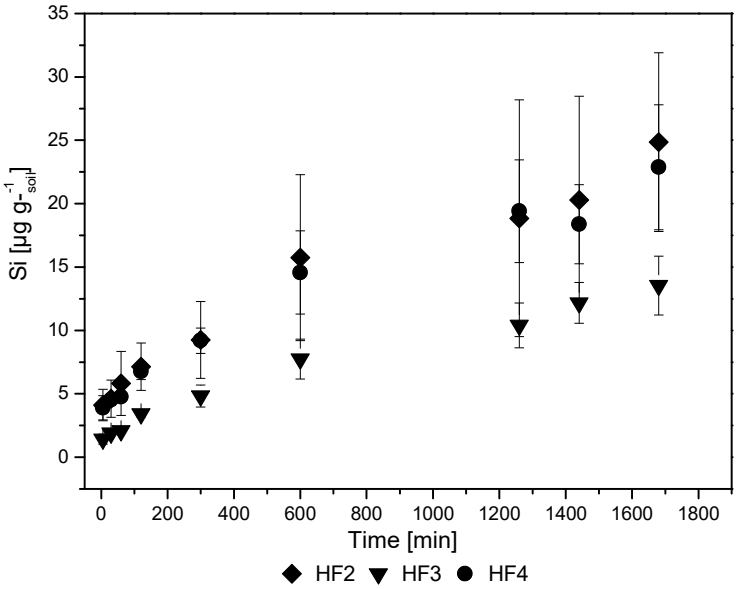
10. APPENDIX



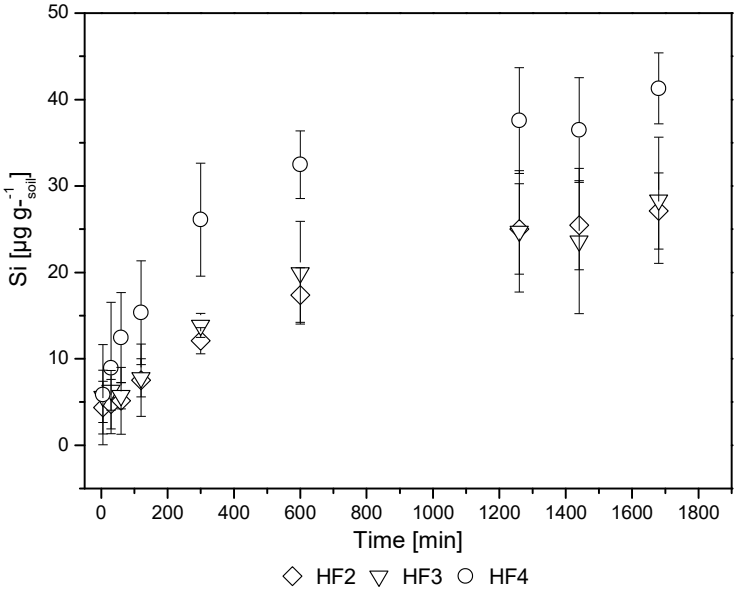
Silicon (Si) release from untreated topsoil samples of oil palm plantation core plots [H02-4] during dissolution experiments in simulated rainwater. Dissolution experiments were carried out in a dark incubator on a horizontal shaker (100 RPM). Si dissolutions were measured at 9 different time intervals (5 and 30 min., and 1, 2, 5, 10, 21, 24 and 28 h) and compared using the grand mean of the core plots (± SE, n = 9). LME model with repeated measurement ANOVA at $p \leq 0.05$ and attached post hoc test at confidence level 0.95.



Silicon (Si) release from untreated litter samples of oil palm plantation core plots [H02-4] during dissolution experiments in simulated rainwater. Dissolution experiments were carried out in a dark incubator on a horizontal shaker (100 RPM). Si dissolutions were measured at 9 different time intervals (5 and 30 min., and 1, 2, 5, 10, 21, 24 and 28 h) and compared using the grand mean of the core plots (± SE, n = 9). LME model with repeated measurement ANOVA at $p \leq 0.05$ and attached post hoc test at confidence level 0.95.



Silicon (Si) release from untreated topsoil samples of forest core plots [H02-4] during dissolution experiments in simulated rainwater. Dissolution experiments were carried out in a dark incubator on a horizontal shaker (100 RPM). Si dissolutions were measured at 9 different time intervals (5 and 30 min., and 1, 2, 5, 10, 21, 24 and 28 h) and compared using the grand mean of the core plots (± SE, n = 9). LME model with repeated measurement ANOVA at $p \leq 0.05$ and attached post hoc test at confidence level 0.95.



Silicon (Si) release from untreated litter samples of forest core plots [H02-4] during dissolution experiments in simulated rainwater. Dissolution experiments were carried out in a dark incubator on a horizontal shaker (100 RPM). Si dissolutions were measured at 9 different time intervals (5 and 30 min., and 1, 2, 5, 10, 21, 24 and 28 h) and compared using the grand mean of the core plots (± SE, n = 9). LME model with repeated measurement ANOVA at $p \leq 0.05$ and attached post hoc test at confidence level 0.95.

Stagnic Acrisol (Loamic Cutanic Ochric; Ah-EA-B/E-Btg1-Btg2-Btg3) (Own Foto).

Haplic Acrisol (Loamic Cutanic Ochric; Ah-A/E-E-Bt-Btg1-Btg2-Btg3-Btgc) (Foto: Britta Greenshields)

Si release of untreated (U) oil palm plantation topsoil subsamples [H02-4 (1-3)] during dissolution experiments:

ID: H02_									
Calibration curve	CC1	CC1	CC1	CC1	CC2	CC2	CC2	CC2	CC2
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.09	0.11	0.13	0.15	0.18	0.23	0.29	0.29	0.37
Concentration in solution[mg/L]	0.03	0.06	0.09	0.12	0.17	0.24	0.34	0.34	0.45
Dilution 2,5 times [mg/L]	0.09	0.16	0.23	0.30	0.42	0.60	0.86	0.84	1.14
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.04	0.05
Weight [g]	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97
Water [%]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Si concentration from soil [mg Si/ g soil]	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Si concentration from soil [µg Si/ g soil]	0.72	1.33	1.85	2.38	3.22	4.52	6.33	6.08	8.00

PLOT-ID: H02_2									
Calibration curve	CC1	CC1	CC1	CC1	CC2	CC2	CC2	CC2	CC2
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.09	0.10	0.12	0.14	0.16	0.19	0.23	0.23	0.26
Concentration in solution[mg/L]	0.03	0.05	0.08	0.10	0.14	0.18	0.25	0.25	0.29
Dilution 2,5 times [mg/L]	0.07	0.13	0.19	0.26	0.35	0.45	0.63	0.62	0.73
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.03
Weight [g]	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98
Water [%]	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Si concentration from soil [mg Si/ g soil]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Si concentration from soil [µg Si/ g	0.56	1.08	1.51	2.05	2.71	3.41	4.61	4.42	5.11

soil]

PLOT-ID: H02_3									
Calibration curve	CC1	CC1	CC1	CC1	CC2	CC2	CC2	CC2	CC2
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.07	0.08	0.09	0.10	0.12	0.14	0.18	0.17	0.23
Concentration in solution[mg/L]	0.00	0.02	0.04	0.05	0.08	0.10	0.17	0.15	0.24
Dilution 2,5 times [mg/L]	0.01	0.05	0.09	0.14	0.19	0.26	0.43	0.39	0.60
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03
Weight [g]	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99
Water [%]	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Si concentration from soil [mg Si/ g soil]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si concentration from soil [µg Si/ g soil]	0.08	0.42	0.75	1.06	1.49	1.92	3.16	2.78	4.18
PLOT-ID: H03_1									
Calibration curve	CC1	CC1	CC1	CC1	CC2	CC2	CC2	CC2	CC2
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.08	0.09	0.10	0.11	0.14	0.21	0.27	0.29	0.38
Concentration in solution[mg/L]	0.01	0.03	0.04	0.06	0.11	0.22	0.30	0.34	0.48
Dilution 2,5 times [mg/L]	0.03	0.07	0.11	0.15	0.27	0.54	0.76	0.84	1.20
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.05
Weight [g]	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99
Water [%]	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Si concentration from soil [mg Si/ g	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01

soil]									
Si concentration from soil [µg Si/ g soil]	0.21	0.61	0.87	1.18	2.08	4.04	5.57	6.06	8.44
PLOT-ID: H03_2									
Calibration curve	CC1	CC1	CC1	CC1	CC2	CC2	CC2	CC2	CC2
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.07	0.08	0.09	0.11	0.14	0.20	0.31	0.34	0.47
Concentration in solution[mg/L]	0.01	0.02	0.04	0.06	0.10	0.20	0.37	0.41	0.61
Dilution 2,5 times [mg/L]	0.02	0.06	0.10	0.15	0.26	0.49	0.91	1.03	1.54
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.00	0.00	0.00	0.01	0.01	0.02	0.04	0.04	0.06
Weight [g]	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99
Water [%]	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Si concentration from soil [mg Si/ g soil]	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Si concentration from soil [µg Si/ g soil]	0.15	0.45	0.78	1.15	1.97	3.70	6.71	7.36	10.77
PLOT-ID: H03_3									
Calibration curve	CC1	CC1	CC1	CC1	CC2	CC2	CC2	CC2	CC2
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.07	0.07	0.08	0.09	0.10	0.14	0.20	0.22	0.29
Concentration in solution[mg/L]	-0.01	0.00	0.01	0.03	0.05	0.10	0.20	0.23	0.34
Dilution 2,5 times [mg/L]	-0.01	0.01	0.03	0.07	0.12	0.25	0.51	0.57	0.84
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.04
Weight [g]	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98

Water [%]	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Si concentration from soil [mg Si/ g soil]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Si concentration from soil [µg Si/ g soil]	-0.11	0.08	0.26	0.53	0.96	1.90	3.73	4.09	5.92
PLOT-ID: H04_1									
Calibration curve	CC1	CC1	CC1	CC1	CC2	CC2	CC2	CC2	CC2
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.10	0.13	0.15	0.18	0.22	0.29	0.37	0.41	0.54
Concentration in solution[mg/L]	0.05	0.09	0.13	0.17	0.22	0.34	0.47	0.53	0.72
Dilution 2,5 times [mg/L]	0.13	0.22	0.32	0.43	0.56	0.86	1.16	1.32	1.79
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.08
Weight [g]	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98
Water [%]	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Si concentration from soil [mg Si/ g soil]	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Si concentration from soil [µg Si/ g soil]	1.07	1.79	2.55	3.36	4.29	6.46	8.56	9.51	12.60
PLOT-ID: H04_2									
Treatment	U	U	U	U	U	U	U	U	U
Calibration curve	CC1	CC1	CC1	CC1	CC2	CC2	CC2	CC2	CC2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.10	0.11	0.14	0.16	0.22	0.27	0.36	0.34	0.49
Concentration in solution[mg/L]	0.04	0.07	0.10	0.14	0.23	0.30	0.45	0.42	0.64
Dilution 2,5 times [mg/L]	0.10	0.17	0.26	0.35	0.57	0.75	1.13	1.06	1.61
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Si in 50 ml	0.01	0.01	0.01	0.02	0.03	0.03	0.05	0.05	0.07
Weight [g]	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98
Water [%]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Si concentration from soil [mg Si/ g soil]	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Si concentration from soil [µg Si/ g soil]	0.88	1.42	2.06	2.74	4.41	5.68	8.29	7.60	11.28

PLOT-ID: H04_3									
Calibration curve	CC1	CC1	CC1	CC1	CC2	CC2	CC2	CC2	CC2
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.07	0.08	0.09	0.10	0.12	0.15	0.21	0.23	0.30
Concentration in solution[mg/L]	0.00	0.01	0.03	0.04	0.07	0.12	0.22	0.25	0.35
Dilution 2,5 times [mg/L]	0.00	0.04	0.07	0.10	0.18	0.30	0.54	0.63	0.88
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04
Weight [g]	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99
Water [%]	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Si concentration from soil [mg Si/ g soil]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Si concentration from soil [µg Si/ g soil]	0.02	0.30	0.54	0.82	1.40	2.27	3.95	4.50	6.16

Si release of F1 oil palm plantation topsoil subsamples [H02-4 (1-3)] during dissolution experiments:

PLOT-ID: H02_1									
Calibration curve	CC3	CC3	CC3	CC3	CC3	CC3	CC3	CC3	CC3
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1

Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.70	0.86	1.01	1.24	1.42	1.01	1.03	1.04	1.12
Concentration in solution[mg/L]	1.18	1.49	1.79	2.24	2.60	1.72	1.75	1.78	1.94
Dilution 2,5 times [mg/L]	2.94	3.73	4.47	5.60	6.49	8.58	8.75	8.91	9.69
mg Si in 1 L solution	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Si in 50 ml	0.15	0.18	0.21	0.26	0.30	0.39	0.38	0.38	0.41
Weight [g]	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97
Water [%]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Si concentration from soil [mg Si/ g soil]	0.02	0.03	0.04	0.04	0.05	0.06	0.06	0.06	0.07
Si concentration from soil [µg Si/ g soil]	24.64	30.64	35.93	44.08	50.02	64.64	64.46	64.16	68.15
PLOT-ID: H02_2									
Calibration curve	CC3	CC3	CC3	CC3	CC3	CC3	CC3	CC3	CC3
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.54	0.78	1.00	1.23	1.52	0.94	1.01	1.02	1.02
Concentration in solution[mg/L]	0.88	1.33	1.77	2.22	2.79	1.59	1.72	1.74	1.74
Dilution 2,5 times [mg/L]	2.20	3.33	4.43	5.56	6.98	7.95	8.61	8.69	8.68
mg Si in 1 L solution	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Si in 50 ml	0.11	0.16	0.21	0.26	0.32	0.36	0.38	0.37	0.36
Weight [g]	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98
Water [%]	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Si concentration from soil [mg Si/ g soil]	0.02	0.03	0.04	0.04	0.05	0.06	0.06	0.06	0.06
Si concentration from soil [µg Si/ g soil]	18.35	27.28	35.59	43.68	53.66	59.79	63.36	62.46	60.94
PLOT-ID: H02_3									
Calibration curve	CC3	CC3	CC3	CC3	CC3	CC3	CC3	CC3	CC3
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1

Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.37	0.48	0.53	0.62	0.67	0.48	0.48	0.42	0.48
Concentration in solution[mg/L]	0.53	0.74	0.85	1.03	1.13	0.71	0.72	0.60	0.72
Dilution 2,5 times [mg/L]	1.33	1.86	2.14	2.57	2.82	3.53	3.60	3.01	3.58
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.07	0.09	0.10	0.12	0.13	0.16	0.16	0.13	0.15
Weight [g]	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99
Water [%]	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Si concentration from soil [mg Si/ g soil]	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.03
Si concentration from soil [µg Si/ g soil]	11.12	15.19	17.13	20.16	21.69	26.53	26.43	21.60	25.09

PLOT-ID: H03_1

Calibration curve	CC4	CC4	CC4	CC4	CC4	CC4	CC4	CC4	CC4
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.26	0.19	0.33	0.37	0.40	0.46	0.50	0.50	0.50
Concentration in solution[mg/L]	0.30	0.16	0.42	0.50	0.57	0.68	0.75	0.75	0.75
Dilution 5 times [mg/L]	1.51	0.82	2.11	2.50	2.85	3.42	3.74	3.74	3.75
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.08	0.04	0.10	0.12	0.13	0.15	0.16	0.16	0.16
Weight [g]	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99
Water [%]	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Si concentration from soil [mg Si/ g soil]	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03
Si concentration from soil [µg Si/ g soil]	12.58	6.73	16.95	19.65	21.86	25.67	27.47	26.85	26.29

PLOT-ID: H03_2

Calibration curve	CC4	CC4	CC4	CC4	CC4	CC4	CC4	CC4	CC4
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.29	0.37	0.46	0.50	0.56	0.64	0.70	0.70	0.70
Concentration in solution[mg/L]	0.36	0.50	0.67	0.74	0.86	1.01	1.12	1.13	1.13
Dilution 5 times [mg/L]	1.80	2.50	3.33	3.71	4.31	5.05	5.61	5.63	5.64
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Si in 50 ml	0.09	0.12	0.16	0.17	0.20	0.23	0.25	0.24	0.24
Weight [g]	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99
Water [%]	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Si concentration from soil [mg Si/ g soil]	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04	0.04
Si concentration from soil [µg Si/ g soil]	15.03	20.48	26.69	29.11	33.09	37.94	41.22	40.42	39.54

PLOT-ID: H03_3

Calibration curve	CC4	CC4	CC4	CC4	CC4	CC4	CC4	CC4	CC4
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.19	0.22	0.28	0.34	0.45	0.50	0.50	0.55	0.57
Concentration in solution[mg/L]	0.16	0.22	0.34	0.46	0.65	0.74	0.74	0.85	0.89
Dilution 5 times [mg/L]	0.79	1.12	1.68	2.28	3.27	3.72	3.71	4.25	4.44
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.04	0.05	0.08	0.11	0.15	0.17	0.16	0.18	0.19
Weight [g]	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98
Water [%]	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Si concentration from soil [mg Si/ g soil]	0.01	0.01	0.01	0.02	0.03	0.03	0.03	0.03	0.03
Si concentration from soil [µg Si/ g soil]	6.63	9.15	13.46	17.89	25.18	27.99	27.30	30.58	31.20

PLOT-ID: H04_1									
Calibration curve	CC5	CC5	CC5	CC5	CC5	CC5	CC5	CC5	CC5
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.31	0.41	0.44	0.53	0.62	0.44	0.50	0.46	0.47
Concentration in solution[mg/L]	0.41	0.61	0.67	0.86	1.03	0.61	0.71	0.65	0.67
Dilution 2,5 times [mg/L]	1.03	1.53	1.67	2.15	2.57	3.05	3.54	3.27	3.33
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.05	0.08	0.08	0.10	0.12	0.14	0.16	0.14	0.14
Weight [g]	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98
Water [%]	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Si concentration from soil [mg Si/ g soil]	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.02	0.02
Si concentration from soil [µg Si/ g soil]	8.63	12.56	13.41	16.87	19.80	22.93	26.08	23.51	23.40

PLOT-ID: H04_2									
Calibration curve	CC5	CC5	CC5	CC5	CC5	CC5	CC5	CC5	CC5
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.26	0.36	0.41	0.44	0.56	0.38	0.40	0.41	0.45
Concentration in solution[mg/L]	0.32	0.51	0.62	0.68	0.91	0.51	0.53	0.55	0.62
Dilution 2,5 times [mg/L]	0.80	1.28	1.56	1.70	2.27	2.53	2.67	2.74	3.10
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.04	0.06	0.07	0.08	0.10	0.11	0.12	0.12	0.13
Weight [g]	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98
Water [%]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Si concentration from soil [mg Si/ g soil]	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02

Si concentration from soil [µg Si/ g soil]	6.65	10.50	12.49	13.35	17.45	19.04	19.66	19.73	21.77
PLOT-ID: H04_3									
Calibration curve	CC5	CC5	CC5	CC5	CC5	CC5	CC5	CC5	CC5
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.20	0.30	0.37	0.43	0.50	0.37	0.38	0.40	0.42
Concentration in solution[mg/L]	0.21	0.40	0.53	0.66	0.80	0.49	0.50	0.54	0.58
Dilution 2,5 times [mg/L]	0.52	1.01	1.32	1.64	1.99	2.47	2.50	2.68	2.89
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.03	0.05	0.06	0.08	0.09	0.11	0.11	0.12	0.12
Weight [g]	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99
Water [%]	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Si concentration from soil [mg Si/ g soil]	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
Si concentration from soil [µg Si/ g soil]	4.31	8.24	10.59	12.87	15.31	18.55	18.33	19.25	20.24

Si release of F2 oil palm plantation topsoil subsamples [H02-4 (1-3)] during dissolution experiments:

PLOT-ID: H02_1									
Calibration curve	CC6	CC6	CC6	CC6	CC6	CC6	CC6	CC6	CC6
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.53	0.55	0.61	0.71	0.83	0.99	1.15	1.20	1.17
Concentration in solution[mg/L]	0.89	0.93	1.04	1.23	1.48	1.79	2.10	2.19	2.15

Dilution 2,5 times [mg/L]	4.44	4.63	5.22	6.17	7.40	8.97	10.50	10.97	10.74
mg Si in 1 L solution	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Si in 50 ml	0.22	0.23	0.25	0.29	0.34	0.40	0.46	0.47	0.45
Weight [g]	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97
Water [%]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Si concentration from soil [mg Si/ g soil]	0.04	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.08
Si concentration from soil [µg Si/ g soil]	37.20	37.98	41.93	48.54	57.02	67.60	77.36	78.99	75.57
PLOT-ID: H02_2									
Calibration curve	CC6	CC6	CC6	CC6	CC6	CC6	CC6	CC6	CC6
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.51	0.52	0.62	0.83	0.84	0.99	1.07	1.11	1.08
Concentration in solution[mg/L]	0.85	0.86	1.06	1.48	1.49	1.78	1.95	2.03	1.96
Dilution 2,5 times [mg/L]	4.27	4.31	5.32	7.41	7.46	8.92	9.73	10.13	9.79
mg Si in 1 L solution	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Si in 50 ml	0.21	0.21	0.26	0.35	0.34	0.40	0.43	0.44	0.41
Weight [g]	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98
Water [%]	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Si concentration from soil [mg Si/ g soil]	0.04	0.04	0.04	0.06	0.06	0.07	0.07	0.07	0.07
Si concentration from soil [µg Si/ g soil]	35.74	35.35	42.73	58.24	57.38	67.12	71.61	72.87	68.77
PLOT-ID: H02_3									
Calibration curve	CC6	CC6	CC6	CC6	CC6	CC6	CC6	CC6	CC6
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.33	0.32	0.36	0.41	0.50	0.56	0.64	0.76	0.65
Concentration in solution[mg/L]	0.49	0.47	0.55	0.66	0.84	0.94	1.10	1.33	1.12

Dilution 2,5 times [mg/L]	2.44	2.35	2.76	3.30	4.19	4.70	5.49	6.66	5.60
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Si in 50 ml	0.12	0.12	0.13	0.15	0.19	0.21	0.24	0.29	0.24
Weight [g]	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99
Water [%]	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Si concentration from soil [mg Si/ g soil]	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.04
Si concentration from soil [µg Si/ g soil]	20.39	19.26	22.09	25.85	32.15	35.28	40.33	47.78	39.25
PLOT-ID: H03_1									
Calibration curve	CC6	CC6	CC6	CC6	CC6	CC6	CC6	CC6	CC6
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.33	0.33	0.38	0.41	0.48	0.53	0.54	0.55	0.56
Concentration in solution[mg/L]	0.49	0.50	0.59	0.66	0.79	0.89	0.91	0.94	0.95
Dilution 5 times [mg/L]	2.47	2.51	2.95	3.30	3.97	4.47	4.53	4.68	4.74
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.12	0.12	0.14	0.15	0.18	0.20	0.20	0.20	0.20
Weight [g]	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99
Water [%]	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Si concentration from soil [mg Si/ g soil]	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
Si concentration from soil [µg Si/ g soil]	20.64	20.54	23.66	25.85	30.50	33.59	33.27	33.57	33.20
PLOT-ID: H03_2									
Calibration curve	CC6	CC6	CC6	CC6	CC6	CC6	CC6	CC6	CC6
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.27	0.28	0.30	0.35	0.39	0.49	0.54	0.55	0.57

Concentration in solution[mg/L]	0.38	0.41	0.45	0.53	0.62	0.81	0.91	0.94	0.96
Dilution 5 times [mg/L]	1.92	2.03	2.24	2.67	3.10	4.03	4.54	4.68	4.80
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.10	0.10	0.11	0.13	0.14	0.18	0.20	0.20	0.20
Weight [g]	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99
Water [%]	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Si concentration from soil [mg Si/ g soil]	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03
Si concentration from soil [µg Si/ g soil]	16.05	16.62	17.93	20.93	23.80	30.28	33.35	33.57	33.68
PLOT-ID: H03_3									
Calibration curve	CC6	CC6	CC6	CC6	CC6	CC6	CC6	CC6	CC6
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.29	0.29	0.31	0.34	0.45	0.47	0.54	0.57	0.57
Concentration in solution[mg/L]	0.41	0.42	0.46	0.52	0.72	0.78	0.91	0.98	0.97
Dilution 5 times [mg/L]	2.05	2.12	2.32	2.59	3.62	3.90	4.57	4.88	4.87
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.10	0.10	0.11	0.12	0.17	0.18	0.20	0.21	0.20
Weight [g]	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98
Water [%]	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Si concentration from soil [mg Si/ g soil]	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.03
Si concentration from soil [µg Si/ g soil]	17.15	17.37	18.58	20.35	27.83	29.37	33.62	35.11	34.22
PLOT-ID: H04_1									
Calibration curve	CC7	CC7	CC7	CC7	CC7	CC8	CC8	CC8	CC8
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2

Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.31	0.33	0.37	0.40	0.45	0.48	0.56	0.52	0.54
Concentration in solution[mg/L]	0.41	0.43	0.51	0.56	0.65	0.66	0.79	0.73	0.77
Dilution 2,5 times [mg/L]	2.04	2.16	2.53	2.80	3.27	3.32	3.96	3.66	3.87
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Si in 50 ml	0.10	0.11	0.12	0.13	0.15	0.15	0.17	0.16	0.16
Weight [g]	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98
Water [%]	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Si concentration from soil [mg Si/ g soil]	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03
Si concentration from soil [µg Si/ g soil]	17.08	17.73	20.33	22.02	25.18	25.00	29.16	26.28	27.15

PLOT-ID: H04_2

Calibration curve	CC7	CC7	CC7	CC7	CC7	CC8	CC8	CC8	CC8
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.45	0.45	0.56	0.73	0.70	0.86	0.96	0.90	0.91
Concentration in solution[mg/L]	0.65	0.66	0.87	1.18	1.12	1.29	1.45	1.35	1.37
Dilution 2,5 times [mg/L]	3.27	3.28	4.34	5.88	5.59	6.43	7.27	6.76	6.87
mg Si in 1 L solution	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Si in 50 ml	0.16	0.16	0.21	0.28	0.26	0.29	0.32	0.29	0.29
Weight [g]	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98	5.98
Water [%]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Si concentration from soil [mg Si/ g soil]	0.03	0.03	0.03	0.05	0.04	0.05	0.05	0.05	0.05
Si concentration from soil [µg Si/ g soil]	27.37	26.90	34.82	46.24	42.97	48.39	53.47	48.58	48.24

PLOT-ID: H04_3

Calibration curve	CC7	CC7	CC7	CC7	CC7	CC8	CC8	CC8	CC8
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.31	0.33	0.37	0.54	0.55	0.68	0.81	0.82	0.79
Concentration in solution[mg/L]	0.40	0.44	0.51	0.83	0.85	0.99	1.21	1.22	1.16
Dilution 2,5 times [mg/L]	1.98	2.18	2.53	4.17	4.24	4.96	6.06	6.12	5.82
mg Si in 1 L solution	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Si in 50 ml	0.10	0.11	0.12	0.20	0.19	0.22	0.27	0.26	0.24
Weight [g]	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99	5.99
Water [%]	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Si concentration from soil [mg Si/ g soil]	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.04
Si concentration from soil [µg Si/ g soil]	16.51	17.85	20.30	32.73	32.53	37.28	44.50	43.95	40.82

Si release of untreated (U) oil palm plantation litter subsamples [H02-4 (4-6)] during dissolution experiments:

PLOT-ID: H02_4							
Calibration curve	CC9	CC9	CC9	CC9	CC9	CC10	CC10
Treatment	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260
Adsorption	0.065	0.067	0.07	0.077	0.087	0.104	0.118
Concentration in solution[mg/L]	0.011	0.015	0.020	0.032	0.049	0.064	0.080
Dilution 2,5 times [mg/L]	0.029	0.037	0.050	0.080	0.124	0.160	0.200
mg Si in 1 L solution	0.00003	0.00004	0.00005	0.00008	0.00012	0.00016	0.00020
Si in 50 ml	0.0014	0.0018	0.0024	0.0038	0.0057	0.0072	0.0088
Weight [g]	0.491	0.491	0.491	0.491	0.491	0.491	0.491
Water [%]	0.019	0.019	0.019	0.019	0.019	0.019	0.019
Si concentration from soil [mg Si/ g soil]	0.0029	0.0037	0.0049	0.0077	0.0116	0.0146	0.0179

Si concentration from soil [µg Si/ g soil]	2.91	3.71	4.90	7.70	11.59	14.64	17.95
PLOT-ID: H02_5							
Calibration curve	CC9	CC9	CC9	CC9	CC9	CC10	CC10
Treatment	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260
Adsorption	0.064	0.065	0.066	0.079	0.091	0.099	0.126
Concentration in solution[mg/L]	0.010	0.011	0.013	0.036	0.056	0.056	0.093
Dilution 2,5 times [mg/L]	0.024	0.029	0.033	0.089	0.141	0.139	0.232
mg Si in 1 L solution	0.00002	0.00003	0.00003	0.00009	0.00014	0.00014	0.00023
Si in 50 ml	0.0012	0.0014	0.0016	0.0042	0.0065	0.0063	0.0102
Weight [g]	0.491	0.491	0.491	0.491	0.491	0.491	0.491
Water [%]	0.018	0.018	0.018	0.018	0.018	0.018	0.018
Si concentration from soil [mg Si/ g soil]	0.0025	0.0028	0.0032	0.0085	0.0132	0.0127	0.0208
Si concentration from soil [µg Si/ g soil]	2.46	2.85	3.21	8.52	13.20	12.75	20.80
PLOT-ID: H02_6							
Calibration curve	CC9	CC9	CC9	CC9	CC9	CC10	CC10
Treatment	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260
Adsorption	0.06	0.063	0.069	0.07	0.084	0.095	0.117
Concentration in solution[mg/L]	0.003	0.008	0.018	0.020	0.044	0.049	0.078
Dilution 2,5 times [mg/L]	0.007	0.020	0.046	0.050	0.111	0.123	0.196
mg Si in 1 L solution	0.00001	0.00002	0.00005	0.00005	0.00011	0.00012	0.00020
Si in 50 ml	0.0003	0.0010	0.0022	0.0024	0.0051	0.0055	0.0086
Weight [g]	0.492	0.492	0.492	0.492	0.492	0.492	0.492
Water [%]	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Si concentration from soil [mg Si/ g soil]	0.0007	0.0020	0.0045	0.0048	0.0103	0.0112	0.0175
Si concentration from soil [µg Si/ g soil]	0.70	1.98	4.47	4.79	10.34	11.22	17.53

PLOT-ID: H03_4							
Calibration curve	CC9	CC9	CC9	CC9	CC9	CC10	CC10
Treatment	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260
Adsorption	0.076	0.085	0.099	0.107	0.143	0.184	0.264
Concentration in solution[mg/L]	0.030	0.046	0.070	0.084	0.146	0.195	0.314
Dilution 5 times [mg/L]	0.076	0.115	0.175	0.210	0.366	0.488	0.785
mg Si in 1 L solution	0.00008	0.00011	0.00018	0.00021	0.00037	0.00049	0.00079
Si in 50 ml	0.0038	0.0056	0.0084	0.0099	0.0168	0.0220	0.0346
Weight [g]	0.482	0.482	0.482	0.482	0.482	0.482	0.482
Water [%]	0.037	0.037	0.037	0.037	0.037	0.037	0.037
Si concentration from soil [mg Si/ g soil]	0.0079	0.0117	0.0175	0.0205	0.0349	0.0455	0.0717
Si concentration from soil [µg Si/ g soil]	7.90	11.68	17.47	20.48	34.89	45.55	71.69

PLOT-ID: H03_5							
Calibration curve	CC9	CC9	CC9	CC9	CC9	CC10	CC10
Treatment	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260
Adsorption	0.074	0.077	0.086	0.098	0.121	0.151	0.202
Concentration in solution[mg/L]	0.027	0.032	0.048	0.068	0.108	0.141	0.215
Dilution 5 times [mg/L]	0.067	0.080	0.119	0.171	0.270	0.352	0.537
mg Si in 1 L solution	0.00007	0.00008	0.00012	0.00017	0.00027	0.00035	0.00054
Si in 50 ml	0.0034	0.0039	0.0057	0.0080	0.0124	0.0159	0.0236
Weight [g]	0.498	0.498	0.498	0.498	0.498	0.498	0.498
Water [%]	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Si concentration from soil [mg Si/ g soil]	0.0068	0.0079	0.0115	0.0161	0.0250	0.0318	0.0474
Si concentration from soil [µg Si/ g soil]	6.77	7.91	11.49	16.15	24.98	31.85	47.43

PLOT-ID: H03_6

Calibration curve	CC9	CC9	CC9	CC9	CC9	CC10	CC10
Treatment	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260
Adsorption	0.124	0.156	0.163	0.213	0.273	0.364	0.525
Concentration in solution[mg/L]	0.113	0.169	0.181	0.267	0.371	0.491	0.733
Dilution 5 times [mg/L]	0.283	0.422	0.452	0.668	0.927	1.226	1.832
mg Si in 1 L solution	0.00028	0.00042	0.00045	0.00067	0.00093	0.00123	0.00183
Si in 50 ml	0.0142	0.0207	0.0217	0.0314	0.0427	0.0552	0.0806
Weight [g]	0.482	0.482	0.482	0.482	0.482	0.482	0.482
Water [%]	0.036	0.036	0.036	0.036	0.036	0.036	0.036
Si concentration from soil [mg Si/ g soil]	0.0294	0.0429	0.0450	0.0651	0.0885	0.1145	0.1672
Si concentration from soil [µg Si/ g soil]	29.40	42.87	45.01	65.14	88.49	114.50	167.21

PLOT-ID: H04_4

Calibration curve	CC9	CC9	CC9	CC9	CC9	CC10	CC10
Treatment	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260
Adsorption	0.119	0.135	0.142	0.149	0.151	0.165	0.209
Concentration in solution[mg/L]	0.105	0.132	0.144	0.157	0.160	0.164	0.226
Dilution 2,5 times [mg/L]	0.262	0.331	0.361	0.391	0.400	0.410	0.565
mg Si in 1 L solution	0.00026	0.00033	0.00036	0.00039	0.00040	0.00041	0.00056
Si in 50 ml	0.0131	0.0162	0.0173	0.0184	0.0184	0.0184	0.0249
Weight [g]	0.472	0.472	0.472	0.472	0.472	0.472	0.472
Water [%]	0.056	0.056	0.056	0.056	0.056	0.056	0.056
Si concentration from soil [mg Si/ g soil]	0.0277	0.0344	0.0367	0.0390	0.0390	0.0391	0.0527
Si concentration from soil [µg Si/ g soil]	27.74	34.36	36.73	38.98	38.99	39.08	52.66

PLOT-ID: H04_5

Calibration curve	CC9	CC9	CC9	CC9	CC9	CC10	CC10
Treatment	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260
Adsorption	0.078	0.083	0.081	0.107	0.129	0.139	0.188
Concentration in solution[mg/L]	0.034	0.043	0.039	0.084	0.122	0.121	0.192
Dilution 2,5 times [mg/L]	0.085	0.106	0.098	0.210	0.305	0.303	0.481
mg Si in 1 L solution	0.00008	0.00011	0.00010	0.00021	0.00031	0.00030	0.00048
Si in 50 ml	0.0042	0.0052	0.0047	0.0099	0.0140	0.0136	0.0211
Weight [g]	0.482	0.482	0.482	0.482	0.482	0.482	0.482
Water [%]	0.036	0.036	0.036	0.036	0.036	0.036	0.036
Si concentration from soil [mg Si/ g soil]	0.0088	0.0108	0.0097	0.0205	0.0291	0.0283	0.0439
Si concentration from soil [µg Si/ g soil]	8.78	10.81	9.72	20.48	29.11	28.31	43.88

PLOT-ID: H04_6

Calibration curve	CC9	CC9	CC9	CC9	CC9	CC10	CC10
Treatment	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260
Adsorption	0.069	0.082	0.087	0.096	0.109	0.119	0.153
Concentration in solution[mg/L]	0.018	0.041	0.049	0.065	0.087	0.088	0.136
Dilution 2,5 times [mg/L]	0.046	0.102	0.124	0.162	0.219	0.221	0.340
mg Si in 1 L solution	0.00005	0.00010	0.00012	0.00016	0.00022	0.00022	0.00034
Si in 50 ml	0.0023	0.0050	0.0059	0.0076	0.0101	0.0100	0.0150
Weight [g]	0.479	0.479	0.479	0.479	0.479	0.479	0.479
Water [%]	0.043	0.043	0.043	0.043	0.043	0.043	0.043
Si concentration from soil [mg Si/ g soil]	0.0048	0.0104	0.0124	0.0159	0.0210	0.0208	0.0313
Si concentration from soil [µg Si/ g soil]	4.79	10.43	12.38	15.94	21.00	20.78	31.27

Si release of F1 oil palm plantation litter subsamples [H02-4 (4-6)] during dissolution experiments:

PLOT-ID: H02_4									
Calibration curve	CC11	CC11	CC11	CC11	CC11	CC12	CC12	CC12	CC12
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.108	0.11	0.111	0.14	0.172	0.21	0.257	0.268	0.28
Concentration in solution[mg/L]	0.081	0.084	0.086	0.131	0.181	0.240	0.312	0.328	0.347
Dilution 2,5 times [mg/L]	0.406	0.422	0.430	0.655	0.903	1.202	1.558	1.642	1.733
mg Si in 1 L solution	0.00041	0.00042	0.00043	0.00065	0.00090	0.00120	0.00156	0.00164	0.00173
Si in 50 ml	0.0203	0.0207	0.0206	0.0308	0.0415	0.0541	0.0686	0.0706	0.0728
Weight [g]	0.491	0.491	0.491	0.491	0.491	0.491	0.491	0.491	0.491
Water [%]	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
Si concentration from soil [mg Si/ g soil]	0.0414	0.0421	0.0420	0.0627	0.0846	0.1102	0.1396	0.1438	0.1482
Si concentration from soil [µg Si/ g soil]	41.39	42.11	42.01	62.67	84.59	110.19	139.65	143.77	148.20

PLOT-ID: H02_5									
Calibration curve	CC11	CC11	CC11	CC11	CC11	CC12	CC12	CC12	CC12
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.094	0.108	0.109	0.135	0.171	0.21	0.266	0.286	0.285
Concentration in solution[mg/L]	0.060	0.081	0.083	0.123	0.179	0.240	0.325	0.356	0.354
Dilution 2,5 times [mg/L]	0.298	0.406	0.414	0.616	0.895	1.202	1.627	1.778	1.770
mg Si in 1 L solution	0.00030	0.00041	0.00041	0.00062	0.00090	0.00120	0.00163	0.00178	0.00177
Si in 50 ml	0.0149	0.0199	0.0199	0.0289	0.0412	0.0541	0.0716	0.0765	0.0744

Weight [g]	0.491	0.491	0.491	0.491	0.491	0.491	0.491	0.491	0.491
Water [%]	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
Si concentration from soil [mg Si/ g soil]	0.0303	0.0406	0.0405	0.0590	0.0839	0.1102	0.1458	0.1557	0.1514
Si concentration from soil [µg Si/ g soil]	30.33	40.56	40.49	58.95	83.86	110.19	145.76	155.71	151.44

PLOT-ID: H02_6									
Calibration curve	CC11	CC11	CC11	CC11	CC11	CC12	CC12	CC12	CC12
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.136	0.14	0.144	0.158	0.186	0.22	0.26	0.29	0.299
Concentration in solution[mg/L]	0.125	0.131	0.137	0.159	0.202	0.256	0.316	0.362	0.375
Dilution 2,5 times [mg/L]	0.624	0.655	0.686	0.794	1.011	1.278	1.581	1.808	1.877
mg Si in 1 L solution	0.00062	0.00065	0.00069	0.00079	0.00101	0.00128	0.00158	0.00181	0.00188
Si in 50 ml	0.0312	0.0321	0.0329	0.0373	0.0465	0.0575	0.0696	0.0778	0.0788
Weight [g]	0.492	0.492	0.492	0.492	0.492	0.492	0.492	0.492	0.492
Water [%]	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Si concentration from soil [mg Si/ g soil]	0.0634	0.0652	0.0669	0.0759	0.0946	0.1169	0.1414	0.1580	0.1602
Si concentration from soil [µg Si/ g soil]	63.38	65.20	66.90	75.88	94.57	116.89	141.40	158.05	160.19

PLOT-ID: H03_4									
Calibration curve	CC11	CC11	CC11	CC11	CC11	CC12	CC12	CC12	CC12
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.294	0.298	0.301	0.318	0.329	0.361	0.396	0.44	0.439
Concentration in solution[mg/L]	0.370	0.376	0.381	0.407	0.424	0.469	0.522	0.589	0.587
Dilution 5 times [mg/L]	1.849	1.880	1.904	2.035	2.121	2.346	2.611	2.945	2.937

mg Si in 1 L solution	0.00185	0.00188	0.00190	0.00204	0.00212	0.00235	0.00261	0.00294	0.00294
Si in 50 ml	0.0925	0.0921	0.0914	0.0957	0.0976	0.1056	0.1149	0.1266	0.1234
Weight [g]	0.482	0.482	0.482	0.482	0.482	0.482	0.482	0.482	0.482
Water [%]	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037
Si concentration from soil [mg Si/ g soil]	0.1918	0.1911	0.1896	0.1985	0.2024	0.2190	0.2384	0.2627	0.2559
Si concentration from soil [µg Si/ g soil]	191.83	191.14	189.56	198.47	202.39	219.04	238.38	262.70	255.93

PLOT-ID: H03_5									
Calibration curve	CC11	CC11	CC11	CC11	CC11	CC12	CC12	CC12	CC12
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.232	0.234	0.244	0.247	0.297	0.36	0.405	0.432	0.434
Concentration in solution[mg/L]	0.274	0.277	0.292	0.297	0.374	0.468	0.536	0.577	0.580
Dilution 5 times [mg/L]	1.368	1.384	1.461	1.485	1.872	2.339	2.680	2.884	2.899
mg Si in 1 L solution	0.00137	0.00138	0.00146	0.00148	0.00187	0.00234	0.00268	0.00288	0.00290
Si in 50 ml	0.0684	0.0678	0.0701	0.0698	0.0861	0.1052	0.1179	0.1240	0.1218
Weight [g]	0.498	0.498	0.498	0.498	0.498	0.498	0.498	0.498	0.498
Water [%]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Si concentration from soil [mg Si/ g soil]	0.1374	0.1362	0.1409	0.1401	0.1730	0.2113	0.2367	0.2490	0.2445
Si concentration from soil [µg Si/ g soil]	137.38	136.16	140.86	140.12	172.96	211.32	236.75	249.03	244.51

PLOT-ID: H03_6									
Calibration curve	CC11	CC11	CC11	CC11	CC11	CC12	CC12	CC12	CC12
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	1.048	1.12	1.332	1.534	1.872	2.16	2.186	2.52	2.577

Concentration in solution[mg/L]	1.540	1.651	1.980	2.294	2.818	3.195	3.234	3.740	3.827
Dilution 5 times [mg/L]	7.698	8.256	9.901	11.468	14.089	15.975	16.172	18.702	19.134
mg Si in 1 L solution	0.00770	0.00826	0.00990	0.01147	0.01409	0.01598	0.01617	0.01870	0.01913
Si in 50 ml	0.3849	0.4046	0.4752	0.5390	0.6481	0.7189	0.7116	0.8042	0.8036
Weight [g]	0.482	0.482	0.482	0.482	0.482	0.482	0.482	0.482	0.482
Water [%]	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
Si concentration from soil [mg Si/ g soil]	0.7985	0.8393	0.9860	1.1182	1.3446	1.4914	1.4763	1.6685	1.6673
Si concentration from soil [µg Si/ g soil]	798.53	839.33	985.96	1118.21	1344.63	1491.44	1476.28	1668.46	1667.29

PLOT-ID: H04_4									
Calibration curve	CC11	CC11	CC11	CC11	CC11	CC12	CC12	CC12	CC12
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.509	0.428	0.447	0.404	0.469	0.54	0.614	0.622	0.625
Concentration in solution[mg/L]	0.703	0.578	0.607	0.540	0.641	0.740	0.853	0.865	0.869
Dilution 2,5 times [mg/L]	3.517	2.889	3.036	2.702	3.207	3.702	4.263	4.323	4.346
mg Si in 1 L solution	0.00352	0.00289	0.00304	0.00270	0.00321	0.00370	0.00426	0.00432	0.00435
Si in 50 ml	0.1758	0.1415	0.1457	0.1270	0.1475	0.1666	0.1876	0.1859	0.1825
Weight [g]	0.472	0.472	0.472	0.472	0.472	0.472	0.472	0.472	0.472
Water [%]	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056
Si concentration from soil [mg Si/ g soil]	0.3726	0.2999	0.3087	0.2691	0.3125	0.3530	0.3974	0.3939	0.3867
Si concentration from soil [µg Si/ g soil]	372.55	299.88	308.74	269.10	312.51	352.97	397.39	393.88	386.74

PLOT-ID: H04_5									
Calibration curve	CC11	CC11	CC11	CC11	CC11	CC12	CC12	CC12	CC12
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1

Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.663	0.634	0.708	0.775	0.814	0.993	1.197	1.095	1.164
Concentration in solution[mg/L]	0.942	0.897	1.012	1.116	1.177	1.427	1.736	1.581	1.686
Dilution 2,5 times [mg/L]	4.711	4.487	5.061	5.580	5.883	7.134	8.680	7.907	8.430
mg Si in 1 L solution	0.00471	0.00449	0.00506	0.00558	0.00588	0.00713	0.00868	0.00791	0.00843
Si in 50 ml	0.2356	0.2198	0.2429	0.2623	0.2706	0.3210	0.3819	0.3400	0.3540
Weight [g]	0.482	0.482	0.482	0.482	0.482	0.482	0.482	0.482	0.482
Water [%]	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
Si concentration from soil [mg Si/ g soil]	0.4887	0.4561	0.5040	0.5441	0.5614	0.6660	0.7923	0.7054	0.7345
Si concentration from soil [µg Si/ g soil]	488.74	456.10	503.95	544.13	561.42	666.05	792.32	705.38	734.52

PLOT-ID: H04_6									
Calibration curve	CC11	CC11	CC11	CC11	CC11	CC12	CC12	CC12	CC12
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.406	0.367	0.387	0.411	0.445	0.522	0.546	0.582	0.587
Concentration in solution[mg/L]	0.544	0.483	0.514	0.551	0.604	0.713	0.750	0.804	0.812
Dilution 2,5 times [mg/L]	2.718	2.415	2.571	2.757	3.020	3.566	3.748	4.020	4.058
mg Si in 1 L solution	0.00272	0.00242	0.00257	0.00276	0.00302	0.00357	0.00375	0.00402	0.00406
Si in 50 ml	0.1359	0.1184	0.1234	0.1296	0.1389	0.1605	0.1649	0.1729	0.1705
Weight [g]	0.479	0.479	0.479	0.479	0.479	0.479	0.479	0.479	0.479
Water [%]	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043
Si concentration from soil [mg Si/ g soil]	0.2837	0.2471	0.2576	0.2705	0.2901	0.3350	0.3443	0.3609	0.3558
Si concentration from soil [µg Si/ g soil]	283.71	247.09	257.60	270.50	290.07	335.00	344.26	360.92	355.85

Si release of F2 oil palm plantation litter subsamples [H02-4 (4-6)] during dissolution

experiments:

PLOT-ID: H02_4	CC13	CC13	CC13	CC13	CC13	CC14	CC14	CC14	CC14
Calibration curve	F2	F2	F2	F2	F2	F2	F2	F2	F2
Treatment	5	30	60	120	300	600	1260	1440	1680
Time [min]	0.417	0.464	0.465	0.509	0.52	0.634	0.629	0.546	0.636
Adsorption	0.601	0.688	0.690	0.771	0.792	0.919	0.911	0.776	0.923
Concentration in solution[mg/L]	3.005	3.440	3.449	3.856	3.958	4.597	4.556	3.882	4.613
Dilution 2,5 times [mg/L]	0.00301	0.00344	0.00345	0.00386	0.00396	0.00460	0.00456	0.00388	0.00461
mg Si in 1 L solution	0.1503	0.1686	0.1656	0.1813	0.1821	0.2068	0.2005	0.1669	0.1937
Si in 50 ml	0.491	0.491	0.491	0.491	0.491	0.491	0.491	0.491	0.491
Weight [g]	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
Water [%]	0.3060	0.3433	0.3372	0.3691	0.3708	0.4213	0.4083	0.3400	0.3946
Si concentration from soil [mg Si/ g soil]	306.03	343.30	337.20	369.15	370.83	421.28	408.28	340.01	394.59
Si concentration from soil [µg Si/ g soil]									

PLOT-ID: H02_5									
Calibration curve	CC13	CC13	CC13	CC13	CC13	CC14	CC14	CC14	CC14
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.335	0.307	0.334	0.383	0.39	0.478	0.567	0.554	0.633
Concentration in solution[mg/L]	0.449	0.397	0.447	0.538	0.551	0.666	0.811	0.789	0.918
Dilution 2,5 times [mg/L]	2.246	1.987	2.237	2.691	2.755	3.331	4.053	3.947	4.589
mg Si in 1 L solution	0.00225	0.00199	0.00224	0.00269	0.00276	0.00333	0.00405	0.00395	0.00459
Si in 50 ml	0.1123	0.0974	0.1074	0.1265	0.1267	0.1499	0.1783	0.1697	0.1927
Weight [g]	0.491	0.491	0.491	0.491	0.491	0.491	0.491	0.491	0.491
Water [%]	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
Si concentration from soil [mg Si/ g soil]	0.2288	0.1983	0.2187	0.2576	0.2581	0.3053	0.3632	0.3457	0.3925

Si concentration from soil [µg Si/ g soil]	228.77	198.34	218.71	257.55	258.14	305.25	363.19	345.70	392.50
PLOT-ID: H02_6									
Calibration curve	CC13	CC13	CC13	CC13	CC13	CC14	CC14	CC14	CC14
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.291	0.293	0.298	0.312	0.341	0.398	0.454	0.437	0.472
Concentration in solution[mg/L]	0.368	0.372	0.381	0.407	0.460	0.536	0.627	0.600	0.656
Dilution 2,5 times [mg/L]	1.839	1.858	1.904	2.034	2.302	2.681	3.136	2.998	3.282
mg Si in 1 L solution	0.00184	0.00186	0.00190	0.00203	0.00230	0.00268	0.00314	0.00300	0.00328
Si in 50 ml	0.0920	0.0910	0.0914	0.0956	0.1059	0.1207	0.1380	0.1289	0.1378
Weight [g]	0.492	0.492	0.492	0.492	0.492	0.492	0.492	0.492	0.492
Water [%]	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Si concentration from soil [mg Si/ g soil]	0.1869	0.1850	0.1858	0.1943	0.2152	0.2452	0.2804	0.2620	0.2802
Si concentration from soil [µg Si/ g soil]	186.93	185.03	185.77	194.27	215.23	245.25	280.44	262.01	280.17
PLOT-ID: H03_4									
Calibration curve	CC15	CC15	CC15	CC15	CC15	CC15	CC15	CC15	CC15
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.54	0.495	0.474	0.454	0.447	0.428	0.446	0.409	0.461
Concentration in solution[mg/L]	0.912	0.826	0.786	0.747	0.734	0.698	0.732	0.661	0.761
Dilution 5 times [mg/L]	4.562	4.130	3.929	3.737	3.670	3.488	3.660	3.306	3.804
mg Si in 1 L solution	0.00456	0.00413	0.00393	0.00374	0.00367	0.00349	0.00366	0.00331	0.00380
Si in 50 ml	0.2281	0.2024	0.1886	0.1756	0.1688	0.1569	0.1611	0.1421	0.1598
Weight [g]	0.482	0.482	0.482	0.482	0.482	0.482	0.482	0.482	0.482
Water [%]	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037
Si concentration from soil [mg Si/ g	0.4732	0.4199	0.3913	0.3644	0.3502	0.3256	0.3341	0.2949	0.3315

soil]									
Si concentration from soil [µg Si/ g soil]	473.21	419.88	391.25	364.40	350.24	325.62	334.14	294.89	331.48
PLOT-ID: H03_5									
Calibration curve	CC15	CC15	CC15	CC15	CC15	CC15	CC15	CC15	CC15
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.526	0.464	0.441	0.42	0.427	0.42	0.432	0.448	0.428
Concentration in solution[mg/L]	0.886	0.767	0.722	0.682	0.696	0.682	0.705	0.736	0.698
Dilution 5 times [mg/L]	4.428	3.833	3.612	3.411	3.478	3.411	3.526	3.680	3.488
mg Si in 1 L solution	0.00443	0.00383	0.00361	0.00341	0.00348	0.00341	0.00353	0.00368	0.00349
Si in 50 ml	0.2214	0.1878	0.1734	0.1603	0.1600	0.1535	0.1551	0.1582	0.1465
Weight [g]	0.498	0.498	0.498	0.498	0.498	0.498	0.498	0.498	0.498
Water [%]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Si concentration from soil [mg Si/ g soil]	0.4445	0.3771	0.3482	0.3219	0.3213	0.3082	0.3115	0.3177	0.2941
Si concentration from soil [µg Si/ g soil]	444.53	377.14	348.18	321.92	321.27	308.22	311.54	317.71	294.15
PLOT-ID: H03_6									
Calibration curve	CC16	CC16	CC16	CC16	CC16	CC16	CC16	CC16	CC16
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	1.626	1.477	1.457	1.47	1.43	1.447	0.625	1.401	1.488
Concentration in solution[mg/L]	2.919	2.709	2.671	2.696	2.619	2.652	1.075	2.564	2.731
Dilution 5 times [mg/L]	14.595	13.547	13.355	13.480	13.096	13.259	5.377	12.818	13.653
mg Si in 1 L solution	0.01459	0.01355	0.01336	0.01348	0.01310	0.01326	0.00538	0.01282	0.01365
Si in 50 ml	0.7297	0.6638	0.6411	0.6336	0.6024	0.5967	0.2366	0.5512	0.5734
Weight [g]	0.482	0.482	0.482	0.482	0.482	0.482	0.482	0.482	0.482

Water [%]	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
Si concentration from soil [mg Si/ g soil]	1.5140	1.3772	1.3300	1.3144	1.2499	1.2379	0.4908	1.1435	1.1897
Si concentration from soil [µg Si/ g soil]	1513.96	1377.20	1330.00	1314.45	1249.87	1237.92	490.83	1143.55	1189.65
PLOT-ID: H04_4									
Calibration curve	CC16	CC16	CC16	CC16	CC16	CC16	CC16	CC16	CC16
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.562	0.468	0.481	0.452	0.153	0.499	1.418	0.522	0.508
Concentration in solution[mg/L]	0.925	0.774	0.799	0.744	0.170	0.834	2.596	0.878	0.851
Dilution 2,5 times [mg/L]	4.626	3.871	3.996	3.718	0.851	4.169	12.981	4.389	4.255
mg Si in 1 L solution	0.00463	0.00387	0.00400	0.00372	0.00085	0.00417	0.01298	0.00439	0.00425
Si in 50 ml	0.2313	0.1897	0.1918	0.1747	0.0391	0.1876	0.5712	0.1887	0.1787
Weight [g]	0.472	0.472	0.472	0.472	0.472	0.472	0.472	0.472	0.472
Water [%]	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056
Si concentration from soil [mg Si/ g soil]	0.4901	0.4019	0.4064	0.3702	0.0829	0.3974	1.2101	0.3999	0.3786
Si concentration from soil [µg Si/ g soil]	490.09	401.89	406.37	370.21	82.90	397.43	1210.13	399.86	378.61
PLOT-ID: H04_5									
Calibration curve	CC16	CC16	CC16	CC16	CC16	CC16	CC16	CC16	CC16
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.872	0.753	0.739	0.75	0.748	0.848	0.888	0.848	0.842
Concentration in solution[mg/L]	1.506	1.321	1.294	1.315	1.311	1.503	1.580	1.503	1.492
Dilution 2,5 times [mg/L]	7.531	6.604	6.470	6.576	6.556	7.515	7.899	7.515	7.458
mg Si in 1 L solution	0.00753	0.00660	0.00647	0.00658	0.00656	0.00752	0.00790	0.00752	0.00746

Si in 50 ml	0.3765	0.3236	0.3106	0.3091	0.3016	0.3382	0.3476	0.3232	0.3132
Weight [g]	0.482	0.482	0.482	0.482	0.482	0.482	0.482	0.482	0.482
Water [%]	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
Si concentration from soil [mg Si/ g soil]	0.7812	0.6714	0.6443	0.6412	0.6257	0.7016	0.7211	0.6705	0.6499
Si concentration from soil [µg Si/ g soil]	781.20	671.39	644.32	641.19	625.71	701.64	721.06	670.46	649.85
PLOT-ID: H04_6									
Calibration curve	CC16	CC16	CC16	CC16	CC16	CC16	CC16	CC16	CC16
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.657	0.595	0.607	0.743	0.631	0.637	0.643	0.606	0.7
Concentration in solution[mg/L]	1.103	1.018	1.041	1.302	1.087	1.098	1.110	1.039	1.219
Dilution 2,5 times [mg/L]	5.516	5.089	5.204	6.508	5.434	5.492	5.549	5.195	6.096
mg Si in 1 L solution	0.00552	0.00509	0.00520	0.00651	0.00543	0.00549	0.00555	0.00519	0.00610
Si in 50 ml	0.2758	0.2494	0.2498	0.3059	0.2500	0.2471	0.2442	0.2234	0.2560
Weight [g]	0.479	0.479	0.479	0.479	0.479	0.479	0.479	0.479	0.479
Water [%]	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043
Si concentration from soil [mg Si/ g soil]	0.5758	0.5206	0.5215	0.6386	0.5219	0.5159	0.5098	0.4663	0.5345
Si concentration from soil [µg Si/ g soil]	575.83	520.61	521.51	638.62	521.88	515.94	509.76	466.33	534.52

Results of dissolution experiments of untreated forest topsoil subsamples [HF2_1-3]:

PLOT-ID: HF2_1									
Calibration curve	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680

Adsorption	0.192	0.237	0.312	0.346	0.431	0.645	0.928	0.962	1.048
Concentration in solution[mg/L]	0.199	0.271	0.391	0.446	0.582	1.023	1.379	1.433	1.571
Dilution 2,5 times [mg/L]	0.497	0.677	0.978	1.114	1.455	2.557	3.447	3.584	3.928
mg Si in 1 L solution	0.000	0.001	0.001	0.001	0.001	0.003	0.003	0.004	0.004
Si in 50 ml	0.0248	0.0332	0.0469	0.0524	0.0669	0.1279	0.1689	0.1720	0.1846
Weight [g]	5.862	5.862	5.862	5.862	5.862	5.862	5.862	5.862	5.862
Water [%]	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Si concentration from soil [mg Si/ g soil]	0.0042	0.0057	0.0080	0.0089	0.0114	0.0218	0.0288	0.0293	0.0315
Si concentration from soil [µg Si/ g soil]	4.24	5.66	8.01	8.93	11.42	21.81	28.82	29.34	31.50
PLOT-ID: HF2_2									
Calibration curve	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.223	0.225	0.264	0.295	0.404	0.515	0.589	0.621	0.867
Concentration in solution[mg/L]	0.248	0.252	0.314	0.364	0.539	0.780	0.835	0.887	1.281
Dilution 2,5 times [mg/L]	0.621	0.629	0.785	0.910	1.347	1.951	2.088	2.217	3.203
mg Si in 1 L solution	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.003
Si in 50 ml	0.0310	0.0308	0.0377	0.0428	0.0619	0.0975	0.1023	0.1064	0.1505
Weight [g]	5.874	5.874	5.874	5.874	5.874	5.874	5.874	5.874	5.874
Water [%]	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
Si concentration from soil [mg Si/ g soil]	0.0053	0.0052	0.0064	0.0073	0.0105	0.0166	0.0174	0.0181	0.0256
Si concentration from soil [µg Si/ g soil]	5.29	5.25	6.42	7.28	10.55	16.60	17.42	18.11	25.63
PLOT-ID: HF2_3									
Calibration curve	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680

Adsorption	0.151	0.156	0.161	0.23	0.252	0.319	0.376	0.477	0.612
Concentration in solution[mg/L]	0.133	0.141	0.149	0.260	0.295	0.414	0.494	0.656	0.872
Dilution 2,5 times [mg/L]	0.332	0.352	0.372	0.649	0.737	1.036	1.234	1.639	2.180
mg Si in 1 L solution	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.002	0.002
Si in 50 ml	0.0166	0.0173	0.0179	0.0305	0.0339	0.0518	0.0605	0.0787	0.1025
Weight [g]	5.868	5.868	5.868	5.868	5.868	5.868	5.868	5.868	5.868
Water [%]	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
Si concentration from soil [mg Si/ g soil]	0.0028	0.0029	0.0030	0.0052	0.0058	0.0088	0.0103	0.0134	0.0175
Si concentration from soil [µg Si/ g soil]	2.83	2.94	3.05	5.20	5.78	8.83	10.31	13.41	17.46
PLOT-ID: HF3_1									
Calibration curve	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.123	0.128	0.131	0.186	0.249	0.331	0.434	0.495	0.575
Concentration in solution[mg/L]	0.088	0.096	0.101	0.189	0.290	0.437	0.587	0.685	0.813
Dilution 5 times [mg/L]	0.220	0.240	0.252	0.473	0.725	1.092	1.467	1.711	2.032
mg Si in 1 L solution	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002	0.002
Si in 50 ml	0.0110	0.0118	0.0121	0.0222	0.0334	0.0546	0.0719	0.0821	0.0955
Weight [g]	5.916	5.916	5.916	5.916	5.916	5.916	5.916	5.916	5.916
Water [%]	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Si concentration from soil [mg Si/ g soil]	0.0019	0.0020	0.0020	0.0038	0.0056	0.0092	0.0121	0.0139	0.0161
Si concentration from soil [µg Si/ g soil]	1.86	1.99	2.05	3.76	5.64	9.23	12.15	13.89	16.14
PLOT-ID: HF3_2									
Calibration curve	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17

Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.107	0.119	0.134	0.173	0.194	0.252	0.328	0.398	0.437
Concentration in solution[mg/L]	0.062	0.082	0.106	0.168	0.202	0.289	0.417	0.529	0.592
Dilution 5 times [mg/L]	0.156	0.204	0.264	0.421	0.505	0.723	1.042	1.323	1.479
mg Si in 1 L solution	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001
Si in 50 ml	0.0078	0.0100	0.0127	0.0198	0.0232	0.0362	0.0511	0.0635	0.0695
Weight [g]	5.934	5.934	5.934	5.934	5.934	5.934	5.934	5.934	5.934
Water [%]	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Si concentration from soil [mg Si/ g soil]	0.0013	0.0017	0.0021	0.0033	0.0039	0.0061	0.0086	0.0107	0.0117
Si concentration from soil [µg Si/ g soil]	1.31	1.69	2.14	3.33	3.91	6.09	8.60	10.70	11.71

PLOT-ID: HF3_3									
Calibration curve	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.101	0.131	0.132	0.17	0.227	0.299	0.385	0.438	0.472
Concentration in solution[mg/L]	0.053	0.101	0.102	0.163	0.255	0.377	0.508	0.593	0.648
Dilution 5 times [mg/L]	0.132	0.252	0.256	0.409	0.637	0.942	1.270	1.483	1.619
mg Si in 1 L solution	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.002
Si in 50 ml	0.0066	0.0124	0.0123	0.0192	0.0293	0.0471	0.0623	0.0712	0.0761
Weight [g]	5.958	5.958	5.958	5.958	5.958	5.958	5.958	5.958	5.958
Water [%]	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Si concentration from soil [mg Si/ g soil]	0.0011	0.0021	0.0021	0.0032	0.0049	0.0079	0.0104	0.0119	0.0128
Si concentration from soil [µg Si/ g soil]	1.11	2.07	2.06	3.22	4.92	7.91	10.45	11.95	12.77

PLOT-ID: HF4_1

Calibration curve	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.179	0.219	0.244	0.28	0.348	0.465	0.596	0.601	0.709
Concentration in solution[mg/L]	0.133	0.197	0.238	0.296	0.405	0.594	0.805	0.813	0.987
Dilution 2,5 times [mg/L]	0.332	0.493	0.594	0.739	1.013	1.484	2.012	2.032	2.467
mg Si in 1 L solution	0.000	0.000	0.001	0.001	0.001	0.001	0.002	0.002	0.002
Si in 50 ml	0.0166	0.0242	0.0285	0.0347	0.0466	0.0668	0.0885	0.0874	0.1036
Weight [g]	5.766	5.766	5.766	5.766	5.766	5.766	5.766	5.766	5.766
Water [%]	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Si concentration from soil [mg Si/ g soil]	0.0029	0.0042	0.0049	0.0060	0.0081	0.0116	0.0154	0.0152	0.0180
Si concentration from soil [µg Si/ g soil]	2.88	4.19	4.95	6.03	8.08	11.59	15.35	15.16	17.97

PLOT-ID: HF4_2

Calibration curve	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.186	0.198	0.199	0.288	0.385	0.448	0.645	0.632	0.93
Concentration in solution[mg/L]	0.189	0.208	0.210	0.353	0.508	0.655	0.925	0.904	1.382
Dilution 2,5 times [mg/L]	0.473	0.521	0.525	0.882	1.270	1.638	2.313	2.261	3.455
mg Si in 1 L solution	0.000	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.003
Si in 50 ml	0.0236	0.0255	0.0252	0.0414	0.0584	0.0819	0.1133	0.1085	0.1624
Weight [g]	5.838	5.838	5.838	5.838	5.838	5.838	5.838	5.838	5.838
Water [%]	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
Si concentration from soil [mg Si/ g soil]	0.0040	0.0044	0.0043	0.0071	0.0100	0.0140	0.0194	0.0186	0.0278
Si concentration from soil [µg Si/ g soil]	4.05	4.37	4.31	7.10	10.01	14.03	19.41	18.59	27.82

PLOT-ID: HF4_3									
Calibration curve	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.208	0.218	0.222	0.292	0.371	0.553	0.771	0.722	0.781
Concentration in solution[mg/L]	0.224	0.240	0.247	0.359	0.486	0.851	1.127	1.049	1.143
Dilution 2,5 times [mg/L]	0.561	0.601	0.617	0.898	1.214	2.128	2.818	2.621	2.858
mg Si in 1 L solution	0.001	0.001	0.001	0.001	0.001	0.002	0.003	0.003	0.003
Si in 50 ml	0.0280	0.0294	0.0296	0.0422	0.0559	0.1064	0.1381	0.1258	0.1343
Weight [g]	5.886	5.886	5.886	5.886	5.886	5.886	5.886	5.886	5.886
Water [%]	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
Si concentration from soil [mg Si/ g soil]	0.0048	0.0050	0.0050	0.0072	0.0095	0.0181	0.0235	0.0214	0.0228
Si concentration from soil [µg Si/ g soil]	4.76	5.00	5.03	7.17	9.49	18.08	23.46	21.38	22.82

Si release of F1 forest topsoil subsamples [HF2-4 (1-3)]: dissolution experiments

PLOT-ID: HF2_1									
Calibration curve	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17	CC17
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.691	0.823	0.993	1.125	1.391	1.54	1.595	1.692	1.861
Concentration in solution[mg/L]	0.999	1.211	1.483	1.695	2.121	2.694	2.449	2.604	2.875
Dilution 2,5 times [mg/L]	4.994	6.053	7.416	8.474	10.607	13.470	12.243	13.020	14.375
mg Si in 1 L solution	0.005	0.006	0.007	0.008	0.011	0.013	0.012	0.013	0.014
Si in 50 ml	0.2497	0.2966	0.3560	0.3983	0.4879	0.6061	0.5387	0.5599	0.6038
Weight [g]	5.862	5.862	5.862	5.862	5.862	5.862	5.862	5.862	5.862
Water [%]	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023

Si concentration from soil [mg Si/ g soil]	0.0426	0.0506	0.0607	0.0679	0.0832	0.1034	0.0919	0.0955	0.1030
Si concentration from soil [µg Si/ g soil]	42.60	50.59	60.72	67.94	83.23	103.40	91.89	95.51	103.00
PLOT-ID: HF2_2									
Calibration curve	CC18	CC18	CC18	CC18	CC18	CC18	CC18	CC18	CC18
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.896	0.824	1.131	1.004	1.575	1.793	1.885	1.887	2.462
Concentration in solution[mg/L]	1.570	1.428	2.031	1.782	2.903	3.332	3.512	3.516	4.646
Dilution 2,5 times [mg/L]	7.848	7.141	10.156	8.909	14.517	16.658	17.561	17.581	23.228
mg Si in 1 L solution	0.008	0.007	0.010	0.009	0.015	0.017	0.018	0.018	0.023
Si in 50 ml	0.3924	0.3499	0.4875	0.4187	0.6678	0.7496	0.7727	0.7560	0.9756
Weight [g]	5.874	5.874	5.874	5.874	5.874	5.874	5.874	5.874	5.874
Water [%]	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
Si concentration from soil [mg Si/ g soil]	0.0668	0.0596	0.0830	0.0713	0.1137	0.1276	0.1315	0.1287	0.1661
Si concentration from soil [µg Si/ g soil]	66.80	59.57	82.99	71.28	113.68	127.61	131.55	128.70	166.09
PLOT-ID: HF2_3									
Calibration curve	CC19	CC19	CC19	CC19	CC19	CC19	CC19	CC19	CC19
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.5	0.539	0.558	0.715	0.842	1.009	1.147	1.169	1.195
Concentration in solution[mg/L]	0.689	0.750	0.779	1.023	1.220	1.451	1.660	1.693	1.733
Dilution 2,5 times [mg/L]	3.447	3.750	3.897	5.115	6.100	7.255	8.301	8.467	8.664
mg Si in 1 L solution	0.003	0.004	0.004	0.005	0.006	0.007	0.008	0.008	0.009
Si in 50 ml	0.1724	0.1837	0.1871	0.2404	0.2806	0.3265	0.3652	0.3641	0.3639
Weight [g]	5.868	5.868	5.868	5.868	5.868	5.868	5.868	5.868	5.868
Water [%]	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022

Si concentration from soil [mg Si/ g soil]	0.0294	0.0313	0.0319	0.0410	0.0478	0.0556	0.0622	0.0620	0.0620
Si concentration from soil [µg Si/ g soil]	29.37	31.31	31.88	40.97	47.82	55.64	62.24	62.05	62.02
PLOT-ID: HF3_1									
Calibration curve	CC19	CC19	CC19	CC19	CC19	CC19	CC19	CC19	CC19
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.647	0.611	0.673	0.796	0.997	1.14	1.163	1.179	1.243
Concentration in solution[mg/L]	0.917	0.862	0.958	1.149	1.460	1.650	1.684	1.709	1.806
Dilution 5 times [mg/L]	4.587	4.308	4.789	5.743	7.302	8.248	8.422	8.543	9.028
mg Si in 1 L solution	0.005	0.004	0.005	0.006	0.007	0.008	0.008	0.009	0.009
Si in 50 ml	0.2294	0.2111	0.2299	0.2699	0.3359	0.3711	0.3706	0.3674	0.3792
Weight [g]	5.916	5.916	5.916	5.916	5.916	5.916	5.916	5.916	5.916
Water [%]	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Si concentration from soil [mg Si/ g soil]	0.0388	0.0357	0.0389	0.0456	0.0568	0.0627	0.0626	0.0621	0.0641
Si concentration from soil [µg Si/ g soil]	38.77	35.68	38.86	45.63	56.78	62.74	62.64	62.10	64.09
PLOT-ID: HF3_2									
Calibration curve	CC19	CC19	CC19	CC19	CC19	CC19	CC19	CC19	CC19
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.436	0.469	0.48	0.592	0.729	0.8	0.97	0.936	1.021
Concentration in solution[mg/L]	0.583	0.633	0.650	0.819	1.027	1.134	1.392	1.340	1.469
Dilution 5 times [mg/L]	2.914	3.164	3.248	4.096	5.134	5.672	6.960	6.702	7.346
mg Si in 1 L solution	0.003	0.003	0.003	0.004	0.005	0.006	0.007	0.007	0.007
Si in 50 ml	0.1457	0.1551	0.1559	0.1925	0.2362	0.2552	0.3062	0.2882	0.3085
Weight [g]	5.934	5.934	5.934	5.934	5.934	5.934	5.934	5.934	5.934

Water [%]	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Si concentration from soil [mg Si/ g soil]	0.0246	0.0261	0.0263	0.0324	0.0398	0.0430	0.0516	0.0486	0.0520
Si concentration from soil [µg Si/ g soil]	24.56	26.13	26.27	32.44	39.80	43.01	51.61	48.57	52.00
PLOT-ID: HF3_3									
Calibration curve	CC18	CC18	CC18	CC18	CC18	CC18	CC18	CC18	CC18
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.406	0.599	0.872	1.034	1.379	1.647	1.886	1.912	2.273
Concentration in solution[mg/L]	0.607	0.986	1.522	1.841	2.518	3.045	3.514	3.565	4.274
Dilution 5 times [mg/L]	1.518	2.466	3.806	4.602	6.296	7.612	8.786	8.913	10.686
mg Si in 1 L solution	0.002	0.002	0.004	0.005	0.006	0.008	0.009	0.009	0.011
Si in 50 ml	0.0759	0.1208	0.1827	0.2163	0.2896	0.3425	0.3866	0.3833	0.4488
Weight [g]	5.958	5.958	5.958	5.958	5.958	5.958	5.958	5.958	5.958
Water [%]	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Si concentration from soil [mg Si/ g soil]	0.0127	0.0203	0.0307	0.0363	0.0486	0.0575	0.0649	0.0643	0.0753
Si concentration from soil [µg Si/ g soil]	12.74	20.28	30.66	36.30	48.61	57.49	64.88	64.33	75.33
PLOT-ID: HF4_1									
Calibration curve	CC18	CC18	CC18	CC18	CC18	CC18	CC18	CC18	CC18
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.828	0.831	1.018	1.308	1.557	1.596	1.632	1.728	2.025
Concentration in solution[mg/L]	1.436	1.442	1.809	2.379	2.868	2.945	3.015	3.204	3.787
Dilution 2,5 times [mg/L]	3.590	3.605	4.523	5.947	7.170	7.362	7.538	8.010	9.468
mg Si in 1 L solution	0.004	0.004	0.005	0.006	0.007	0.007	0.008	0.008	0.009

Si in 50 ml	0.1795	0.1766	0.2171	0.2795	0.3298	0.3313	0.3317	0.3444	0.3977
Weight [g]	5.766	5.766	5.766	5.766	5.766	5.766	5.766	5.766	5.766
Water [%]	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Si concentration from soil [mg Si/ g soil]	0.0311	0.0306	0.0377	0.0485	0.0572	0.0575	0.0575	0.0597	0.0690
Si concentration from soil [µg Si/ g soil]	31.13	30.63	37.65	48.48	57.20	57.45	57.52	59.73	68.97
PLOT-ID: HF4_2									
Calibration curve	CC19	CC19	CC19	CC19	CC19	CC19	CC19	CC19	CC19
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.469	0.531	0.509	0.574	0.842	1.007	1.176	1.161	1.309
Concentration in solution[mg/L]	0.633	0.727	0.693	0.792	1.198	1.448	1.704	1.681	1.906
Dilution 2,5 times [mg/L]	3.164	3.634	3.467	3.960	5.990	7.240	8.520	8.407	9.528
mg Si in 1 L solution	0.003	0.004	0.003	0.004	0.006	0.007	0.009	0.008	0.010
Si in 50 ml	0.1582	0.1781	0.1664	0.1861	0.2755	0.3258	0.3749	0.3615	0.4002
Weight [g]	5.838	5.838	5.838	5.838	5.838	5.838	5.838	5.838	5.838
Water [%]	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
Si concentration from soil [mg Si/ g soil]	0.0271	0.0305	0.0285	0.0319	0.0472	0.0558	0.0642	0.0619	0.0685
Si concentration from soil [µg Si/ g soil]	27.10	30.50	28.51	31.88	47.20	55.81	64.22	61.92	68.55
PLOT-ID: HF4_3									
Calibration curve	CC19	CC19	CC19	CC19	CC19	CC19	CC19	CC19	CC19
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.653	0.664	0.826	0.793	1.033	1.124	1.146	1.245	1.368
Concentration in solution[mg/L]	0.912	0.928	1.174	1.124	1.487	1.625	1.659	1.809	1.995

Dilution 2,5 times [mg/L]	4.56	4.64	5.87	5.62	7.44	8.13	8.29	9.04	9.98
mg Si in 1 L solution	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Si in 50 ml	0.228	0.227	0.282	0.264	0.342	0.366	0.365	0.389	0.419
Weight [g]	5.89	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
Water [%]	0.019	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Si concentration from soil [mg Si/ g soil]	0.039	0.039	0.048	0.045	0.058	0.062	0.062	0.066	0.071
Si concentration from soil [µg Si/ g soil]	38.72	38.80	48.06	45.05	58.36	62.38	62.25	66.34	71.47

Si release of F2 forest topsoil subsamples [HF2-4 (1-3)] during dissolution experiments:

PLOT-ID: HF2_1									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.609	0.617	0.673	0.76	0.837	0.868	0.917	0.909	0.949
Concentration in solution[mg/L]	0.946	0.960	1.056	1.205	1.337	1.391	1.475	1.461	1.530
Dilution 2,5 times [mg/L]	4.731	4.799	5.280	6.026	6.687	6.953	7.373	7.305	7.648
mg Si in 1 L solution	0.005	0.005	0.005	0.006	0.007	0.007	0.007	0.007	0.008
Si in 50 ml	0.2365	0.2352	0.2534	0.2832	0.3076	0.3129	0.3244	0.3141	0.3212
Weight [g]	5.862	5.862	5.862	5.862	5.862	5.862	5.862	5.862	5.862
Water [%]	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Si concentration from soil [mg Si/ g soil]	0.0403	0.0401	0.0432	0.0483	0.0525	0.0534	0.0553	0.0536	0.0548
Si concentration from soil [µg Si/ g soil]	40.35	40.12	43.23	48.32	52.47	53.37	55.34	53.58	54.80
PLOT-ID: HF2_2									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20

Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.635	0.651	0.711	0.859	0.923	1.108	1.214	1.168	1.157
Concentration in solution[mg/L]	0.991	1.018	1.121	1.375	1.485	1.802	1.984	1.905	1.887
Dilution 2,5 times [mg/L]	4.954	5.091	5.606	6.876	7.425	9.012	9.922	9.527	9.433
mg Si in 1 L solution	0.005	0.005	0.006	0.007	0.007	0.009	0.010	0.010	0.009
Si in 50 ml	0.2477	0.2495	0.2691	0.3232	0.3415	0.4056	0.4366	0.4097	0.3962
Weight [g]	5.874	5.874	5.874	5.874	5.874	5.874	5.874	5.874	5.874
Water [%]	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
Si concentration from soil [mg Si/ g soil]	0.0422	0.0425	0.0458	0.0550	0.0581	0.0690	0.0743	0.0697	0.0674
Si concentration from soil [µg Si/ g soil]	42.17	42.47	45.81	55.02	58.15	69.04	74.32	69.74	67.45
PLOT-ID: HF2_3									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.654	0.655	0.754	0.775	0.999	1.126	1.159	0.976	1.261
Concentration in solution[mg/L]	1.023	1.025	1.195	1.231	1.615	1.833	1.890	1.576	2.065
Dilution 2,5 times [mg/L]	5.117	5.125	5.975	6.155	8.077	9.167	9.450	7.880	10.325
mg Si in 1 L solution	0.005	0.005	0.006	0.006	0.008	0.009	0.009	0.008	0.010
Si in 50 ml	0.2558	0.2511	0.2868	0.2893	0.3715	0.4125	0.4158	0.3388	0.4337
Weight [g]	5.868	5.868	5.868	5.868	5.868	5.868	5.868	5.868	5.868
Water [%]	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
Si concentration from soil [mg Si/ g soil]	0.0436	0.0428	0.0489	0.0493	0.0633	0.0703	0.0709	0.0577	0.0739
Si concentration from soil [µg Si/ g soil]	43.60	42.80	48.87	49.30	63.32	70.30	70.86	57.74	73.90
PLOT-ID: HF3_1									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20

Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.547	0.563	0.625	0.729	0.941	1.048	1.152	1.154	1.076
Concentration in solution[mg/L]	0.840	0.867	0.974	1.152	1.516	1.700	1.878	1.881	1.748
Dilution 5 times [mg/L]	4.199	4.336	4.868	5.760	7.579	8.498	9.390	9.407	8.738
mg Si in 1 L solution	0.004	0.004	0.005	0.006	0.008	0.008	0.009	0.009	0.009
Si in 50 ml	0.2099	0.2125	0.2337	0.2707	0.3487	0.3824	0.4132	0.4045	0.3670
Weight [g]	5.916	5.916	5.916	5.916	5.916	5.916	5.916	5.916	5.916
Water [%]	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Si concentration from soil [mg Si/ g soil]	0.0355	0.0359	0.0395	0.0458	0.0589	0.0646	0.0698	0.0684	0.0620
Si concentration from soil [µg Si/ g soil]	35.48	35.91	39.50	45.76	58.93	64.64	69.84	68.37	62.03

PLOT-ID: HF3_2

Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.427	0.453	0.503	0.577	0.742	0.887	1.028	1.067	1.048
Concentration in solution[mg/L]	0.634	0.678	0.764	0.891	1.174	1.423	1.665	1.732	1.700
Dilution 5 times [mg/L]	3.169	3.392	3.821	4.456	5.872	7.116	8.326	8.661	8.498
mg Si in 1 L solution	0.003	0.003	0.004	0.004	0.006	0.007	0.008	0.009	0.008
Si in 50 ml	0.1584	0.1662	0.1834	0.2094	0.2701	0.3202	0.3663	0.3724	0.3569
Weight [g]	5.934	5.934	5.934	5.934	5.934	5.934	5.934	5.934	5.934
Water [%]	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Si concentration from soil [mg Si/ g soil]	0.0267	0.0280	0.0309	0.0353	0.0455	0.0540	0.0617	0.0628	0.0601
Si concentration from soil [µg Si/ g soil]	26.70	28.01	30.91	35.29	45.52	53.96	61.74	62.76	60.14

PLOT-ID: HF3_3									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.513	0.525	0.601	0.717	0.861	1.005	1.058	1.089	1.111
Concentration in solution[mg/L]	0.781	0.802	0.932	1.131	1.379	1.626	1.717	1.770	1.808
Dilution 5 times [mg/L]	3.907	4.010	4.662	5.657	6.893	8.129	8.583	8.849	9.038
mg Si in 1 L solution	0.004	0.004	0.005	0.006	0.007	0.008	0.009	0.009	0.009
Si in 50 ml	0.1953	0.1965	0.2238	0.2659	0.3171	0.3658	0.3777	0.3805	0.3796
Weight [g]	5.958	5.958	5.958	5.958	5.958	5.958	5.958	5.958	5.958
Water [%]	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Si concentration from soil [mg Si/ g soil]	0.0328	0.0330	0.0376	0.0446	0.0532	0.0614	0.0634	0.0639	0.0637
Si concentration from soil [µg Si/ g soil]	32.79	32.98	37.56	44.63	53.22	61.39	63.39	63.87	63.71

PLOT-ID: HF4_1									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.649	0.647	0.703	0.783	0.883	0.972	0.878	0.92	0.952
Concentration in solution[mg/L]	1.015	1.011	1.107	1.245	1.416	1.569	1.408	1.480	1.535
Dilution 2,5 times [mg/L]	5.074	5.057	5.537	6.224	7.082	7.845	7.039	7.399	7.674
mg Si in 1 L solution	0.005	0.005	0.006	0.006	0.007	0.008	0.007	0.007	0.008
Si in 50 ml	0.2537	0.2478	0.2658	0.2925	0.3258	0.3530	0.3097	0.3182	0.3223
Weight [g]	5.766	5.766	5.766	5.766	5.766	5.766	5.766	5.766	5.766
Water [%]	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Si concentration from soil [mg Si/ g soil]	0.0440	0.0430	0.0461	0.0507	0.0565	0.0612	0.0537	0.0552	0.0559
Si concentration from soil [µg	44.00	42.97	46.09	50.73	56.50	61.23	53.71	55.18	55.90

Si/ g soil]

PLOT-ID: HF4_2									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.568	0.59	0.666	0.744	0.917	1.035	1.128	1.136	1.152
Concentration in solution[mg/L]	0.876	0.914	1.044	1.178	1.475	1.677	1.837	1.851	1.878
Dilution 2,5 times [mg/L]	4.379	4.568	5.220	5.889	7.373	8.386	9.184	9.253	9.390
mg Si in 1 L solution	0.004	0.005	0.005	0.006	0.007	0.008	0.009	0.009	0.009
Si in 50 ml	0.2189	0.2238	0.2505	0.2768	0.3392	0.3774	0.4041	0.3979	0.3944
Weight [g]	5.838	5.838	5.838	5.838	5.838	5.838	5.838	5.838	5.838
Water [%]	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
Si concentration from soil [mg Si/ g soil]	0.0375	0.0383	0.0429	0.0474	0.0581	0.0646	0.0692	0.0682	0.0676
Si concentration from soil [µg Si/ g soil]	37.50	38.34	42.92	47.41	58.10	64.64	69.22	68.15	67.55

PLOT-ID: HF4_3									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.558	0.59	0.722	0.838	0.991	1.195	1.292	1.27	1.322
Concentration in solution[mg/L]	0.859	0.914	1.140	1.339	1.602	1.952	2.118	2.080	2.170
Dilution 2,5 times [mg/L]	4.29	4.57	5.70	6.70	8.01	9.76	10.59	10.40	10.85
mg Si in 1 L solution	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Si in 50 ml	0.215	0.224	0.274	0.315	0.368	0.439	0.466	0.447	0.456
Weight [g]	5.89	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
Water [%]	0.019	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Si concentration from soil [mg	0.036	0.038	0.047	0.054	0.063	0.075	0.079	0.076	0.078

Si/ g soil]									
Si concentration from soil [µg Si/ g soil]	36.47	38.18	46.68	53.68	62.84	74.91	79.50	76.31	77.73

Si release of F2 forest topsoil subsamples [HF2-4 (1-3)] during dissolution experiments:

PLOT-ID: HF2_1									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.609	0.617	0.673	0.76	0.837	0.868	0.917	0.909	0.949
Concentration in solution[mg/L]	0.946	0.960	1.056	1.205	1.337	1.391	1.475	1.461	1.530
Dilution 2,5 times [mg/L]	4.731	4.799	5.280	6.026	6.687	6.953	7.373	7.305	7.648
mg Si in 1 L solution	0.005	0.005	0.005	0.006	0.007	0.007	0.007	0.007	0.008
Si in 50 ml	0.2365	0.2352	0.2534	0.2832	0.3076	0.3129	0.3244	0.3141	0.3212
Weight [g]	5.862	5.862	5.862	5.862	5.862	5.862	5.862	5.862	5.862
Water [%]	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Si concentration from soil [mg Si/ g soil]	0.0403	0.0401	0.0432	0.0483	0.0525	0.0534	0.0553	0.0536	0.0548
Si concentration from soil [µg Si/ g soil]	40.35	40.12	43.23	48.32	52.47	53.37	55.34	53.58	54.80

PLOT-ID: HF2_2									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.635	0.651	0.711	0.859	0.923	1.108	1.214	1.168	1.157
Concentration in solution[mg/L]	0.991	1.018	1.121	1.375	1.485	1.802	1.984	1.905	1.887
Dilution 2,5 times [mg/L]	4.954	5.091	5.606	6.876	7.425	9.012	9.922	9.527	9.433
mg Si in 1 L solution	0.005	0.005	0.006	0.007	0.007	0.009	0.010	0.010	0.009
Si in 50 ml	0.2477	0.2495	0.2691	0.3232	0.3415	0.4056	0.4366	0.4097	0.3962
Weight [g]	5.874	5.874	5.874	5.874	5.874	5.874	5.874	5.874	5.874

Water [%]	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
Si concentration from soil [mg Si/ g soil]	0.0422	0.0425	0.0458	0.0550	0.0581	0.0690	0.0743	0.0697	0.0674
Si concentration from soil [µg Si/ g soil]	42.17	42.47	45.81	55.02	58.15	69.04	74.32	69.74	67.45
PLOT-ID: HF2_3									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.654	0.655	0.754	0.775	0.999	1.126	1.159	0.976	1.261
Concentration in solution[mg/L]	1.023	1.025	1.195	1.231	1.615	1.833	1.890	1.576	2.065
Dilution 2,5 times [mg/L]	5.117	5.125	5.975	6.155	8.077	9.167	9.450	7.880	10.325
mg Si in 1 L solution	0.005	0.005	0.006	0.006	0.008	0.009	0.009	0.008	0.010
Si in 50 ml	0.2558	0.2511	0.2868	0.2893	0.3715	0.4125	0.4158	0.3388	0.4337
Weight [g]	5.868	5.868	5.868	5.868	5.868	5.868	5.868	5.868	5.868
Water [%]	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
Si concentration from soil [mg Si/ g soil]	0.0436	0.0428	0.0489	0.0493	0.0633	0.0703	0.0709	0.0577	0.0739
Si concentration from soil [µg Si/ g soil]	43.60	42.80	48.87	49.30	63.32	70.30	70.86	57.74	73.90
PLOT-ID: HF3_1									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.547	0.563	0.625	0.729	0.941	1.048	1.152	1.154	1.076
Concentration in solution[mg/L]	0.840	0.867	0.974	1.152	1.516	1.700	1.878	1.881	1.748
Dilution 5 times [mg/L]	4.199	4.336	4.868	5.760	7.579	8.498	9.390	9.407	8.738
mg Si in 1 L solution	0.004	0.004	0.005	0.006	0.008	0.008	0.009	0.009	0.009

Si in 50 ml	0.2099	0.2125	0.2337	0.2707	0.3487	0.3824	0.4132	0.4045	0.3670
Weight [g]	5.916	5.916	5.916	5.916	5.916	5.916	5.916	5.916	5.916
Water [%]	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Si concentration from soil [mg Si/ g soil]	0.0355	0.0359	0.0395	0.0458	0.0589	0.0646	0.0698	0.0684	0.0620
Si concentration from soil [µg Si/ g soil]	35.48	35.91	39.50	45.76	58.93	64.64	69.84	68.37	62.03
PLOT-ID: HF3_2									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.427	0.453	0.503	0.577	0.742	0.887	1.028	1.067	1.048
Concentration in solution[mg/L]	0.634	0.678	0.764	0.891	1.174	1.423	1.665	1.732	1.700
Dilution 5 times [mg/L]	3.169	3.392	3.821	4.456	5.872	7.116	8.326	8.661	8.498
mg Si in 1 L solution	0.003	0.003	0.004	0.004	0.006	0.007	0.008	0.009	0.008
Si in 50 ml	0.1584	0.1662	0.1834	0.2094	0.2701	0.3202	0.3663	0.3724	0.3569
Weight [g]	5.934	5.934	5.934	5.934	5.934	5.934	5.934	5.934	5.934
Water [%]	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Si concentration from soil [mg Si/ g soil]	0.0267	0.0280	0.0309	0.0353	0.0455	0.0540	0.0617	0.0628	0.0601
Si concentration from soil [µg Si/ g soil]	26.70	28.01	30.91	35.29	45.52	53.96	61.74	62.76	60.14
PLOT-ID: HF3_3									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.513	0.525	0.601	0.717	0.861	1.005	1.058	1.089	1.111
Concentration in solution[mg/L]	0.781	0.802	0.932	1.131	1.379	1.626	1.717	1.770	1.808

Dilution 5 times [mg/L]	3.907	4.010	4.662	5.657	6.893	8.129	8.583	8.849	9.038
mg Si in 1 L solution	0.004	0.004	0.005	0.006	0.007	0.008	0.009	0.009	0.009
Si in 50 ml	0.1953	0.1965	0.2238	0.2659	0.3171	0.3658	0.3777	0.3805	0.3796
Weight [g]	5.958	5.958	5.958	5.958	5.958	5.958	5.958	5.958	5.958
Water [%]	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Si concentration from soil [mg Si/ g soil]	0.0328	0.0330	0.0376	0.0446	0.0532	0.0614	0.0634	0.0639	0.0637
Si concentration from soil [µg Si/ g soil]	32.79	32.98	37.56	44.63	53.22	61.39	63.39	63.87	63.71
PLOT-ID: HF4_1									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.649	0.647	0.703	0.783	0.883	0.972	0.878	0.92	0.952
Concentration in solution[mg/L]	1.015	1.011	1.107	1.245	1.416	1.569	1.408	1.480	1.535
Dilution 2,5 times [mg/L]	5.074	5.057	5.537	6.224	7.082	7.845	7.039	7.399	7.674
mg Si in 1 L solution	0.005	0.005	0.006	0.006	0.007	0.008	0.007	0.007	0.008
Si in 50 ml	0.2537	0.2478	0.2658	0.2925	0.3258	0.3530	0.3097	0.3182	0.3223
Weight [g]	5.766	5.766	5.766	5.766	5.766	5.766	5.766	5.766	5.766
Water [%]	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Si concentration from soil [mg Si/ g soil]	0.0440	0.0430	0.0461	0.0507	0.0565	0.0612	0.0537	0.0552	0.0559
Si concentration from soil [µg Si/ g soil]	44.00	42.97	46.09	50.73	56.50	61.23	53.71	55.18	55.90
PLOT-ID: HF4_2									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680

Adsorption	0.568	0.59	0.666	0.744	0.917	1.035	1.128	1.136	1.152
Concentration in solution[mg/L]	0.876	0.914	1.044	1.178	1.475	1.677	1.837	1.851	1.878
Dilution 2,5 times [mg/L]	4.379	4.568	5.220	5.889	7.373	8.386	9.184	9.253	9.390
mg Si in 1 L solution	0.004	0.005	0.005	0.006	0.007	0.008	0.009	0.009	0.009
Si in 50 ml	0.2189	0.2238	0.2505	0.2768	0.3392	0.3774	0.4041	0.3979	0.3944
Weight [g]	5.838	5.838	5.838	5.838	5.838	5.838	5.838	5.838	5.838
Water [%]	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
Si concentration from soil [mg Si/ g soil]	0.0375	0.0383	0.0429	0.0474	0.0581	0.0646	0.0692	0.0682	0.0676
Si concentration from soil [µg Si/ g soil]	37.50	38.34	42.92	47.41	58.10	64.64	69.22	68.15	67.55
PLOT-ID: HF4_3									
Calibration curve	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20	CC20
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.558	0.59	0.722	0.838	0.991	1.195	1.292	1.27	1.322
Concentration in solution[mg/L]	0.859	0.914	1.140	1.339	1.602	1.952	2.118	2.080	2.170
Dilution 2,5 times [mg/L]	4.29	4.57	5.70	6.70	8.01	9.76	10.59	10.40	10.85
mg Si in 1 L solution	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Si in 50 ml	0.215	0.224	0.274	0.315	0.368	0.439	0.466	0.447	0.456
Weight [g]	5.89	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
Water [%]	0.019	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Si concentration from soil [mg Si/ g soil]	0.036	0.038	0.047	0.054	0.063	0.075	0.079	0.076	0.078
Si concentration from soil [µg Si/ g soil]	36.47	38.18	46.68	53.68	62.84	74.91	79.50	76.31	77.73

Si realease of untreated (U) forest litter subsamples [HF2-3 (4-6)] during dissolution experiments:

PLOT-ID: HF2_4									
Calibration curve	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.068	0.07	0.068	0.075	0.094	0.106	0.125	0.128	0.139
Concentration in solution[mg/L]	0.006	0.010	0.006	0.019	0.055	0.077	0.113	0.118	0.139
Dilution 2,5 times [mg/L]	0.016	0.025	0.016	0.049	0.137	0.193	0.282	0.296	0.347
mg Si in 1 L solution	0.00002	0.00003	0.00002	0.00005	0.00014	0.00019	0.00028	0.00030	0.00035
Si in 50 ml	0.0008	0.0012	0.0008	0.0023	0.0063	0.0087	0.0124	0.0127	0.0146
Weight [g]	0.473	0.473	0.473	0.473	0.473	0.473	0.473	0.473	0.473
Water [%]	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055
Si concentration from soil [mg Si/ g soil]	0.0017	0.0026	0.0016	0.0048	0.0134	0.0184	0.0262	0.0269	0.0309
Si concentration from soil [µg Si/ g soil]	1.68	2.61	1.61	4.83	13.35	18.39	26.24	26.92	30.85

PLOT-ID: HF2_5									
Calibration curve	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.072	0.072	0.074	0.076	0.087	0.095	0.108	0.11	0.117
Concentration in solution[mg/L]	0.014	0.014	0.018	0.021	0.042	0.057	0.081	0.085	0.098
Dilution 2,5 times [mg/L]	0.035	0.035	0.044	0.053	0.105	0.142	0.203	0.212	0.245
mg Si in 1 L solution	0.00003	0.00003	0.00004	0.00005	0.00010	0.00014	0.00020	0.00021	0.00024
Si in 50 ml	0.0017	0.0017	0.0021	0.0025	0.0048	0.0064	0.0089	0.0091	0.0103
Weight [g]	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.462
Water [%]	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
Si concentration from soil [mg Si/ g soil]	0.0037	0.0037	0.0046	0.0054	0.0104	0.0138	0.0193	0.0197	0.0222
Si concentration from soil [µg Si/ g soil]	3.74	3.67	4.56	5.42	10.42	13.83	19.30	19.73	22.25

PLOT-ID: HF2_6									
Calibration curve	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.08	0.081	0.084	0.091	0.092	0.109	0.132	0.134	0.132
Concentration in solution[mg/L]	0.029	0.031	0.036	0.049	0.051	0.083	0.126	0.130	0.126
Dilution 2,5 times [mg/L]	0.072	0.077	0.091	0.123	0.128	0.207	0.315	0.324	0.315
mg Si in 1 L solution	0.00007	0.00008	0.00009	0.00012	0.00013	0.00021	0.00031	0.00032	0.00031
Si in 50 ml	0.0036	0.0038	0.0043	0.0058	0.0059	0.0093	0.0139	0.0139	0.0132
Weight [g]	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469
Water [%]	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
Si concentration from soil [mg Si/ g soil]	0.0077	0.0080	0.0093	0.0124	0.0126	0.0199	0.0295	0.0297	0.0282
Si concentration from soil [µg Si/ g soil]	7.67	8.00	9.27	12.36	12.55	19.90	29.53	29.72	28.19

PLOT-ID: HF3_4									
Calibration curve	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.073	0.076	0.079	0.085	0.095	0.112	0.138	0.141	0.152
Concentration in solution[mg/L]	0.016	0.021	0.027	0.038	0.057	0.089	0.137	0.143	0.163
Dilution 5 times [mg/L]	0.039	0.053	0.067	0.095	0.142	0.221	0.343	0.357	0.408
mg Si in 1 L solution	0.00004	0.00005	0.00007	0.00010	0.00014	0.00022	0.00034	0.00036	0.00041
Si in 50 ml	0.0020	0.0026	0.0032	0.0045	0.0065	0.0100	0.0151	0.0153	0.0171
Weight [g]	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471
Water [%]	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
Si concentration from soil [mg Si/ g soil]	0.0042	0.0055	0.0069	0.0095	0.0139	0.0212	0.0320	0.0326	0.0364
Si concentration from soil [µg Si/ g soil]	4.16	5.54	6.85	9.51	13.87	21.15	32.02	32.57	36.40

PLOT-ID: HF3_5									
Calibration curve	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.083	0.083	0.078	0.083	0.098	0.121	0.12	0.117	0.128
Concentration in solution[mg/L]	0.034	0.034	0.025	0.034	0.062	0.105	0.103	0.098	0.118
Dilution 5 times [mg/L]	0.086	0.086	0.063	0.086	0.156	0.263	0.259	0.245	0.296
mg Si in 1 L solution	0.00009	0.00009	0.00006	0.00009	0.00016	0.00026	0.00026	0.00024	0.00030
Si in 50 ml	0.0043	0.0042	0.0030	0.0040	0.0072	0.0119	0.0114	0.0105	0.0124
Weight [g]	0.470	0.470	0.470	0.470	0.470	0.470	0.470	0.470	0.470
Water [%]	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060
Si concentration from soil [mg Si/ g soil]	0.0091	0.0090	0.0064	0.0086	0.0153	0.0252	0.0242	0.0224	0.0265
Si concentration from soil [µg Si/ g soil]	9.14	8.96	6.39	8.59	15.27	25.22	24.22	22.39	26.46

PLOT-ID: HF3_6									
Calibration curve	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.072	0.074	0.073	0.076	0.092	0.095	0.106	0.102	0.118
Concentration in solution[mg/L]	0.014	0.018	0.016	0.021	0.051	0.057	0.077	0.070	0.100
Dilution 5 times [mg/L]	0.035	0.044	0.039	0.053	0.128	0.142	0.193	0.175	0.249
mg Si in 1 L solution	0.00003	0.00004	0.00004	0.00005	0.00013	0.00014	0.00019	0.00017	0.00025
Si in 50 ml	0.0017	0.0022	0.0019	0.0025	0.0059	0.0064	0.0085	0.0075	0.0105
Weight [g]	0.472	0.472	0.472	0.472	0.472	0.472	0.472	0.472	0.472
Water [%]	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056
Si concentration from soil [mg Si/ g soil]	0.0037	0.0046	0.0040	0.0053	0.0125	0.0135	0.0180	0.0159	0.0222

Si concentration from soil [µg Si/ g soil]	3.66	4.56	3.99	5.30	12.47	13.54	18.02	15.91	22.19
PLOT-ID: HF4_4									
Calibration curve	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.111	0.121	0.131	0.143	0.178	0.189	0.211	0.21	0.211
Concentration in solution[mg/L]	0.023	0.039	0.056	0.075	0.131	0.149	0.184	0.183	0.184
Dilution 2,5 times [mg/L]	0.058	0.099	0.139	0.187	0.328	0.373	0.461	0.457	0.461
mg Si in 1 L solution	0.00006	0.00010	0.00014	0.00019	0.00033	0.00037	0.00046	0.00046	0.00046
Si in 50 ml	0.0029	0.0048	0.0067	0.0088	0.0151	0.0168	0.0203	0.0197	0.0194
Weight [g]	0.455	0.455	0.455	0.455	0.455	0.455	0.455	0.455	0.455
Water [%]	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
Si concentration from soil [mg Si/ g soil]	0.0064	0.0106	0.0147	0.0193	0.0332	0.0369	0.0446	0.0432	0.0426
Si concentration from soil [µg Si/ g soil]	6.42	10.63	14.66	19.35	33.19	36.85	44.60	43.21	42.58
PLOT-ID: HF4_5									
Calibration curve	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.096	0.098	0.112	0.117	0.147	0.176	0.184	0.189	0.218
Concentration in solution[mg/L]	-0.001	0.002	0.025	0.033	0.081	0.128	0.141	0.149	0.196
Dilution 2,5 times [mg/L]	-0.002	0.006	0.062	0.083	0.203	0.320	0.352	0.373	0.489
mg Si in 1 L solution	0.00000	0.00001	0.00006	0.00008	0.00020	0.00032	0.00035	0.00037	0.00049
Si in 50 ml	-0.0001	0.0003	0.0030	0.0039	0.0094	0.0144	0.0155	0.0160	0.0206
Weight [g]	0.461	0.461	0.461	0.461	0.461	0.461	0.461	0.461	0.461
Water [%]	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.078

Si concentration from soil [mg Si/ g soil]	-0.0002	0.0006	0.0065	0.0084	0.0203	0.0313	0.0336	0.0348	0.0446
Si concentration from soil [µg Si/ g soil]	-0.22	0.64	6.50	8.42	20.30	31.26	33.64	34.76	44.59

PLOT-ID: HF4_6									
Calibration curve	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21
Treatment	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.087	0.096	0.098	0.103	0.118	0.129	0.142	0.137	0.151
Concentration in solution[mg/L]	0.042	0.059	0.062	0.072	0.100	0.120	0.145	0.135	0.161
Dilution 2,5 times [mg/L]	0.105	0.147	0.156	0.179	0.249	0.301	0.361	0.338	0.404
mg Si in 1 L solution	0.00010	0.00015	0.00016	0.00018	0.00025	0.00030	0.00036	0.00034	0.00040
Si in 50 ml	0.0052	0.0072	0.0075	0.0084	0.0115	0.0135	0.0159	0.0145	0.0169
Weight [g]	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.462
Water [%]	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
Si concentration from soil [mg Si/ g soil]	0.0113	0.0156	0.0162	0.0182	0.0248	0.0293	0.0344	0.0315	0.0367
Si concentration from soil [µg Si/ g soil]	11.33	15.55	16.21	18.24	24.83	29.30	34.43	31.47	36.68

Si release of F1 forest litter subsamples [HF2-3 (4-6)] during dissolution experiments:

PLOT-ID: HF2_4									
Calibration curve	CC22	CC22	CC22	CC22	CC22	CC22	CC22	CC22	CC22
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.2	0.177	0.192	0.189	0.19	0.22	0.227	0.239	0.245
Concentration in solution[mg/L]	0.226	0.184	0.212	0.206	0.208	0.263	0.276	0.297	0.308
Dilution 2,5 times [mg/L]	1.131	0.921	1.058	1.031	1.040	1.314	1.378	1.487	1.542
mg Si in 1 L solution	0.00113	0.00092	0.00106	0.00103	0.00104	0.00131	0.00138	0.00149	0.00154

Si in 50 ml	0.0566	0.0451	0.0508	0.0484	0.0478	0.0591	0.0606	0.0640	0.0648
Weight [g]	0.473	0.473	0.473	0.473	0.473	0.473	0.473	0.473	0.473
Water [%]	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055
Si concentration from soil [mg Si/ g soil]	0.1197	0.0955	0.1075	0.1025	0.1012	0.1251	0.1283	0.1354	0.1371
Si concentration from soil [µg Si/ g soil]	119.70	95.51	107.49	102.52	101.23	125.13	128.31	135.37	137.09
PLOT-ID: HF2_5									
Calibration curve	CC22	CC22	CC22	CC22	CC22	CC22	CC22	CC22	CC22
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.285	0.233	0.242	0.232	0.255	0.277	0.29	0.268	0.285
Concentration in solution[mg/L]	0.382	0.287	0.303	0.285	0.327	0.367	0.391	0.350	0.382
Dilution 2,5 times [mg/L]	1.908	1.433	1.515	1.424	1.634	1.835	1.953	1.752	1.908
mg Si in 1 L solution	0.00191	0.00143	0.00151	0.00142	0.00163	0.00183	0.00195	0.00175	0.00191
Si in 50 ml	0.0954	0.0702	0.0727	0.0669	0.0751	0.0826	0.0860	0.0754	0.0801
Weight [g]	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.462
Water [%]	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
Si concentration from soil [mg Si/ g soil]	0.2067	0.1519	0.1574	0.1448	0.1627	0.1787	0.1860	0.1631	0.1734
Si concentration from soil [µg Si/ g soil]	206.69	151.95	157.39	144.82	162.66	178.70	186.05	163.11	173.44
PLOT-ID: HF2_6									
Calibration curve	CC22	CC22	CC22	CC22	CC22	CC22	CC22	CC22	CC22
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.175	0.161	0.167	0.167	0.168	0.192	0.183	0.195	0.208
Concentration in solution[mg/L]	0.181	0.155	0.166	0.166	0.168	0.212	0.195	0.217	0.241
Dilution 2,5 times [mg/L]	0.903	0.775	0.830	0.830	0.839	1.058	0.976	1.085	1.204
mg Si in 1 L solution	0.00090	0.00077	0.00083	0.00083	0.00084	0.00106	0.00098	0.00109	0.00120

Si in 50 ml	0.0451	0.0380	0.0398	0.0390	0.0386	0.0476	0.0429	0.0467	0.0506
Weight [g]	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469
Water [%]	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
Si concentration from soil [mg Si/ g soil]	0.0962	0.0810	0.0849	0.0831	0.0823	0.1015	0.0915	0.0995	0.1078
Si concentration from soil [µg Si/ g soil]	96.24	80.95	84.91	83.14	82.27	101.52	91.55	99.52	107.84
PLOT-ID: HF3_4									
Calibration curve	CC22	CC22	CC22	CC22	CC22	CC22	CC22	CC22	CC22
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.155	0.135	0.211	0.157	0.172	0.192	0.227	0.235	0.252
Concentration in solution[mg/L]	0.144	0.107	0.246	0.148	0.175	0.212	0.276	0.290	0.321
Dilution 5 times [mg/L]	0.720	0.537	1.232	0.738	0.875	1.058	1.378	1.451	1.606
mg Si in 1 L solution	0.00072	0.00054	0.00123	0.00074	0.00088	0.00106	0.00138	0.00145	0.00161
Si in 50 ml	0.0360	0.0263	0.0591	0.0347	0.0403	0.0476	0.0606	0.0624	0.0675
Weight [g]	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471
Water [%]	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
Si concentration from soil [mg Si/ g soil]	0.0764	0.0559	0.1255	0.0737	0.0855	0.1011	0.1287	0.1325	0.1432
Si concentration from soil [µg Si/ g soil]	76.43	55.89	125.52	73.67	85.49	101.09	128.72	132.46	143.23
PLOT-ID: HF3_5									
Calibration curve	CC22	CC22	CC22	CC22	CC22	CC22	CC22	CC22	CC22
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.138	0.127	0.131	0.142	0.482	0.166	0.189	0.278	0.207
Concentration in solution[mg/L]	0.113	0.093	0.100	0.120	0.742	0.164	0.206	0.369	0.239

Dilution 5 times [mg/L]	0.565	0.464	0.501	0.601	3.708	0.820	1.031	1.844	1.195
mg Si in 1 L solution	0.00056	0.00046	0.00050	0.00060	0.00371	0.00082	0.00103	0.00184	0.00120
Si in 50 ml	0.0282	0.0227	0.0240	0.0283	0.1706	0.0369	0.0453	0.0793	0.0502
Weight [g]	0.470	0.470	0.470	0.470	0.470	0.470	0.470	0.470	0.470
Water [%]	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060
Si concentration from soil [mg Si/ g soil]	0.0601	0.0484	0.0511	0.0601	0.3629	0.0786	0.0965	0.1687	0.1068
Si concentration from soil [µg Si/ g soil]	60.07	48.39	51.14	60.12	362.89	78.56	96.49	168.69	106.80
PLOT-ID: HF3_6									
Calibration curve	CC22	CC22	CC22	CC22	CC22	CC22	CC22	CC22	CC22
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.117	0.113	0.115	0.124	0.14	0.16	0.184	0.188	0.197
Concentration in solution[mg/L]	0.075	0.067	0.071	0.087	0.117	0.153	0.197	0.204	0.221
Dilution 5 times [mg/L]	0.373	0.336	0.355	0.437	0.583	0.766	0.985	1.022	1.104
mg Si in 1 L solution	0.00037	0.00034	0.00035	0.00044	0.00058	0.00077	0.00098	0.00102	0.00110
Si in 50 ml	0.0186	0.0165	0.0170	0.0205	0.0268	0.0345	0.0433	0.0439	0.0464
Weight [g]	0.472	0.472	0.472	0.472	0.472	0.472	0.472	0.472	0.472
Water [%]	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056
Si concentration from soil [mg Si/ g soil]	0.0395	0.0349	0.0361	0.0435	0.0568	0.0730	0.0918	0.0931	0.0982
Si concentration from soil [µg Si/ g soil]	39.49	34.91	36.05	43.49	56.81	73.00	91.82	93.06	98.21
PLOT-ID: HF4_4									
Calibration curve	CC23	CC23	CC23	CC23	CC23	CC23	CC23	CC23	CC23
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680

Adsorption	0.482	0.442	0.445	0.468	0.554	0.647	0.859	0.864	0.885
Concentration in solution[mg/L]	0.801	0.724	0.730	0.774	0.939	1.118	1.524	1.534	1.574
Dilution 2,5 times [mg/L]	4.006	3.622	3.651	3.871	4.696	5.588	7.621	7.669	7.870
mg Si in 1 L solution	0.00401	0.00362	0.00365	0.00387	0.00470	0.00559	0.00762	0.00767	0.00787
Si in 50 ml	0.2003	0.1775	0.1752	0.1820	0.2160	0.2515	0.3353	0.3298	0.3305
Weight [g]	0.455	0.455	0.455	0.455	0.455	0.455	0.455	0.455	0.455
Water [%]	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
Si concentration from soil [mg Si/ g soil]	0.4402	0.3901	0.3851	0.3999	0.4748	0.5526	0.7370	0.7247	0.7265
Si concentration from soil [µg Si/ g soil]	440.17	390.06	385.13	399.89	474.76	552.64	736.96	724.74	726.48
PLOT-ID: HF4_5									
Calibration curve	CC23	CC23	CC23	CC23	CC23	CC23	CC23	CC23	CC23
Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.265	0.232	0.232	0.256	0.257	0.271	0.296	0.289	0.311
Concentration in solution[mg/L]	0.385	0.322	0.322	0.368	0.370	0.396	0.444	0.431	0.473
Dilution 2,5 times [mg/L]	1.925	1.608	1.608	1.838	1.848	1.982	2.222	2.155	2.366
mg Si in 1 L solution	0.00192	0.00161	0.00161	0.00184	0.00185	0.00198	0.00222	0.00215	0.00237
Si in 50 ml	0.0962	0.0788	0.0772	0.0864	0.0850	0.0892	0.0978	0.0927	0.0994
Weight [g]	0.461	0.461	0.461	0.461	0.461	0.461	0.461	0.461	0.461
Water [%]	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.078
Si concentration from soil [mg Si/ g soil]	0.2087	0.1709	0.1674	0.1874	0.1844	0.1935	0.2121	0.2010	0.2155
Si concentration from soil [µg Si/ g soil]	208.74	170.93	167.45	187.42	184.39	193.49	212.07	200.99	215.53
PLOT-ID: HF4_6									
Calibration curve	CC23	CC23	CC23	CC23	CC23	CC23	CC23	CC23	CC23

Treatment	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.442	0.391	0.386	0.375	0.393	0.401	0.454	0.467	0.462
Concentration in solution[mg/L]	0.724	0.627	0.617	0.596	0.630	0.646	0.747	0.772	0.763
Dilution 2,5 times [mg/L]	3.622	3.133	3.085	2.979	3.152	3.229	3.737	3.862	3.814
mg Si in 1 L solution	0.00362	0.00313	0.00308	0.00298	0.00315	0.00323	0.00374	0.00386	0.00381
Si in 50 ml	0.1811	0.1535	0.1481	0.1400	0.1450	0.1453	0.1644	0.1661	0.1602
Weight [g]	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.462
Water [%]	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
Si concentration from soil [mg Si/ g soil]	0.3924	0.3323	0.3205	0.3031	0.3138	0.3145	0.3559	0.3594	0.3467
Si concentration from soil [µg Si/ g soil]	392.41	332.28	320.52	303.11	313.84	314.49	355.91	359.42	346.71

Si release of F2 forest litter subsamples [HF2-3 (4-6)] during dissolution experiments:

PLOT-ID: HF2_4									
Calibration curve	CC24	CC24	CC24	CC24	CC24	CC24	CC24	CC24	CC24
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.253	0.244	0.253	0.244	0.286	0.296	0.32	0.33	0.35
Concentration in solution[mg/L]	0.435	0.415	0.435	0.415	0.512	0.535	0.591	0.614	0.660
Dilution 2,5 times [mg/L]	2.177	2.073	2.177	2.073	2.560	2.676	2.954	3.070	3.301
mg Si in 1 L solution	0.00218	0.00207	0.00218	0.00207	0.00256	0.00268	0.00295	0.00307	0.00330
Si in 50 ml	0.1089	0.1016	0.1045	0.0974	0.1177	0.1204	0.1300	0.1320	0.1387
Weight [g]	0.473	0.473	0.473	0.473	0.473	0.473	0.473	0.473	0.473
Water [%]	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055
Si concentration from soil [mg Si/ g soil]	0.2304	0.2150	0.2212	0.2062	0.2492	0.2548	0.2750	0.2793	0.2934
Si concentration from soil [µg Si/ g	230.40	214.98	221.18	206.20	249.20	254.81	275.05	279.34	293.45

soil]									
PLOT-ID: HF2_5									
Calibration curve	CC24	CC24	CC24	CC24	CC24	CC24	CC24	CC24	CC24
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.235	0.219	0.233	0.251	0.269	0.284	0.303	0.219	0.332
Concentration in solution[mg/L]	0.394	0.357	0.389	0.431	0.473	0.507	0.551	0.357	0.619
Dilution 2,5 times [mg/L]	1.969	1.783	1.946	2.154	2.363	2.537	2.757	1.783	3.093
mg Si in 1 L solution	0.00197	0.00178	0.00195	0.00215	0.00236	0.00254	0.00276	0.00178	0.00309
Si in 50 ml	0.0984	0.0874	0.0934	0.1012	0.1087	0.1141	0.1213	0.0767	0.1299
Weight [g]	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.462
Water [%]	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
Si concentration from soil [mg Si/ g soil]	0.2133	0.1891	0.2021	0.2191	0.2352	0.2471	0.2625	0.1660	0.2812
Si concentration from soil [µg Si/ g soil]	213.30	189.14	202.13	219.14	235.25	247.06	262.54	165.98	281.15
PLOT-ID: HF2_6									
Calibration curve	CC24	CC24	CC24	CC24	CC24	CC24	CC24	CC24	CC24
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.15	0.135	0.138	0.135	0.137	0.147	0.16	0.152	0.154
Concentration in solution[mg/L]	0.197	0.162	0.169	0.162	0.167	0.190	0.220	0.201	0.206
Dilution 2,5 times [mg/L]	0.984	0.810	0.845	0.810	0.833	0.949	1.100	1.007	1.030
mg Si in 1 L solution	0.00098	0.00081	0.00084	0.00081	0.00083	0.00095	0.00110	0.00101	0.00103
Si in 50 ml	0.0492	0.0397	0.0405	0.0381	0.0383	0.0427	0.0484	0.0433	0.0433
Weight [g]	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469	0.469
Water [%]	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
Si concentration from soil [mg Si/ g soil]	0.1049	0.0846	0.0865	0.0812	0.0817	0.0911	0.1032	0.0923	0.0923

Si concentration from soil [µg Si/ g soil]	104.88	84.62	86.45	81.17	81.72	91.06	103.17	92.32	92.25
PLOT-ID: HF3_4									
Calibration curve	CC24	CC24	CC24	CC24	CC24	CC24	CC24	CC24	CC24
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.499	0.422	0.436	0.412	0.475	0.492	0.524	0.529	0.523
Concentration in solution[mg/L]	1.006	0.827	0.860	0.804	0.950	0.989	1.063	1.075	1.061
Dilution 5 times [mg/L]	5.028	4.136	4.298	4.020	4.750	4.947	5.317	5.375	5.306
mg Si in 1 L solution	0.00503	0.00414	0.00430	0.00402	0.00475	0.00495	0.00532	0.00538	0.00531
Si in 50 ml	0.2514	0.2026	0.2063	0.1889	0.2185	0.2226	0.2340	0.2311	0.2228
Weight [g]	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471	0.471
Water [%]	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
Si concentration from soil [mg Si/ g soil]	0.5337	0.4302	0.4380	0.4011	0.4639	0.4726	0.4968	0.4908	0.4731
Si concentration from soil [µg Si/ g soil]	533.74	430.24	437.99	401.12	463.88	472.61	496.75	490.75	473.14
PLOT-ID: HF3_5									
Calibration curve	CC24	CC24	CC24	CC24	CC24	CC24	CC24	CC24	CC24
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.246	0.23	0.212	0.214	0.227	0.239	0.261	0.28	0.294
Concentration in solution[mg/L]	0.419	0.382	0.340	0.345	0.375	0.403	0.454	0.498	0.530
Dilution 5 times [mg/L]	2.096	1.911	1.702	1.725	1.876	2.015	2.270	2.490	2.652
mg Si in 1 L solution	0.00210	0.00191	0.00170	0.00173	0.00188	0.00202	0.00227	0.00249	0.00265
Si in 50 ml	0.1048	0.0936	0.0817	0.0811	0.0863	0.0907	0.0999	0.1071	0.1114
Weight [g]	0.470	0.470	0.470	0.470	0.470	0.470	0.470	0.470	0.470
Water [%]	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060

Si concentration from soil [mg Si/ g soil]	0.2230	0.1992	0.1738	0.1725	0.1836	0.1929	0.2125	0.2278	0.2370
Si concentration from soil [µg Si/ g soil]	223.00	199.21	173.84	172.54	183.61	192.93	212.51	227.82	237.02
PLOT-ID: HF3_6									
Calibration curve	CC24	CC24	CC24	CC24	CC24	CC24	CC24	CC24	CC24
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.246	0.23	0.212	0.214	0.227	0.239	0.261	0.28	0.294
Concentration in solution[mg/L]	0.419	0.382	0.340	0.345	0.375	0.403	0.454	0.498	0.530
Dilution 5 times [mg/L]	2.096	1.911	1.702	1.725	1.876	2.015	2.270	2.490	2.652
mg Si in 1 L solution	0.00210	0.00191	0.00170	0.00173	0.00188	0.00202	0.00227	0.00249	0.00265
Si in 50 ml	0.1048	0.0936	0.0817	0.0811	0.0863	0.0907	0.0999	0.1071	0.1114
Weight [g]	0.472	0.472	0.472	0.472	0.472	0.472	0.472	0.472	0.472
Water [%]	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056
Si concentration from soil [mg Si/ g soil]	0.2221	0.1984	0.1731	0.1718	0.1828	0.1921	0.2116	0.2269	0.2360
Si concentration from soil [µg Si/ g soil]	222.05	198.36	173.11	171.81	182.83	192.11	211.61	226.86	236.02
PLOT-ID: HF4_4									
Calibration curve	CC25	CC25	CC25	CC25	CC25	CC25	CC25	CC25	CC25
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.255	0.224	0.24	0.239	0.244	0.272	0.291	0.29	0.289
Concentration in solution[mg/L]	0.331	0.272	0.302	0.300	0.310	0.364	0.400	0.398	0.396
Dilution 2,5 times [mg/L]	1.656	1.359	1.512	1.502	1.550	1.819	2.001	1.991	1.982
mg Si in 1 L solution	0.00166	0.00136	0.00151	0.00150	0.00155	0.00182	0.00200	0.00199	0.00198
Si in 50 ml	0.0828	0.0666	0.0726	0.0706	0.0713	0.0818	0.0880	0.0856	0.0832

Weight [g]	0.455	0.455	0.455	0.455	0.455	0.455	0.455	0.455	0.455
Water [%]	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
Si concentration from soil [mg Si/ g soil]	0.1820	0.1463	0.1595	0.1552	0.1567	0.1799	0.1935	0.1882	0.1829
Si concentration from soil [µg Si/ g soil]	181.96	146.31	159.51	155.19	156.74	179.88	193.50	188.20	182.93
PLOT-ID: HF4_5									
Calibration curve	CC25	CC25	CC25	CC25	CC25	CC25	CC25	CC25	CC25
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.339	0.321	0.331	0.361	0.445	0.527	0.621	0.665	0.684
Concentration in solution[mg/L]	0.492	0.458	0.477	0.534	0.695	0.853	1.033	1.117	1.154
Dilution 2,5 times [mg/L]	2.461	2.289	2.384	2.672	3.477	4.264	5.165	5.587	5.769
mg Si in 1 L solution	0.00246	0.00229	0.00238	0.00267	0.00348	0.00426	0.00516	0.00559	0.00577
Si in 50 ml	0.1231	0.1121	0.1145	0.1256	0.1600	0.1919	0.2273	0.2402	0.2423
Weight [g]	0.461	0.461	0.461	0.461	0.461	0.461	0.461	0.461	0.461
Water [%]	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.078
Si concentration from soil [mg Si/ g soil]	0.2669	0.2433	0.2483	0.2724	0.3470	0.4162	0.4930	0.5211	0.5256
Si concentration from soil [µg Si/ g soil]	266.94	243.26	248.27	272.43	346.99	416.19	492.96	521.11	525.59
PLOT-ID: HF4_6									
Calibration curve	CC25	CC25	CC25	CC25	CC25	CC25	CC25	CC25	CC25
Treatment	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.263	0.29	0.248	0.257	0.283	0.311	0.347	0.359	0.376
Concentration in solution[mg/L]	0.347	0.398	0.318	0.335	0.385	0.439	0.508	0.531	0.563
Dilution 2,5 times [mg/L]	1.733	1.991	1.589	1.675	1.924	2.193	2.538	2.653	2.816

mg Si in 1 L solution	0.00173	0.00199	0.00159	0.00167	0.00192	0.00219	0.00254	0.00265	0.00282
Si in 50 ml	0.0866	0.0976	0.0763	0.0787	0.0885	0.0987	0.1117	0.1141	0.1183
Weight [g]	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.462	0.462
Water [%]	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
Si concentration from soil [mg Si/ g soil]	0.1877	0.2112	0.1651	0.1704	0.1916	0.2136	0.2417	0.2469	0.2560
Si concentration from soil [µg Si/ g soil]	187.70	211.21	165.06	170.40	191.59	213.58	241.70	246.92	255.99

Si release of untreated (U) HS during dissolution experiments:

ID: HS_1									
Calibration curve	CC1	CC1	CC1	CC1	CC2	CC2	CC2	CC2	CC2
Treatment:	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.117	0.158	0.209	0.25	0.347	0.406	0.484	0.527	0.548
Concentration in solution [mg/L]	0.074	0.136	0.214	0.276	0.427	0.518	0.639	0.705	0.738
Dilution 2,5 times [mg/L]	0.185	0.341	0.535	0.691	1.068	1.296	1.597	1.764	1.845
mg Si in 1 L solution	0.00018	0.00034	0.00053	0.00069	0.00107	0.00130	0.00160	0.00176	0.00184
Si in 50 ml	0.0092	0.0167	0.0257	0.0325	0.0491	0.0583	0.0703	0.0758	0.0775
Weight [g]	5.810	5.810	5.810	5.810	5.810	5.810	5.810	5.810	5.810
Water [%]	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Si concentration from soil [mg Si/ g soil]	0.0016	0.0029	0.0044	0.0056	0.0085	0.0100	0.0121	0.0131	0.0133
Si concentration from soil [µg Si/ g soil]	1.59	2.87	4.42	5.59	8.45	10.04	12.10	13.05	13.34

ID: HS_2									
Calibration curve	CC1	CC1	CC1	CC1	CC2	CC2	CC2	CC2	CC2
Treatment:	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680

Adsorption	0.116	0.16	0.202	0.256	0.331	0.393	0.516	0.528	0.571
Concentration in solution [mg/L]	0.072	0.139	0.203	0.285	0.402	0.498	0.688	0.707	0.773
Dilution 2,5 times [mg/L]	0.181	0.348	0.508	0.713	1.006	1.246	1.721	1.767	1.934
mg Si in 1 L solution	0.00018	0.00035	0.00051	0.00071	0.00101	0.00125	0.00172	0.00177	0.00193
Si in 50 ml	0.0091	0.0171	0.0244	0.0335	0.0463	0.0560	0.0757	0.0760	0.0812
Weight [g]	5.580	5.580	5.580	5.580	5.580	5.580	5.580	5.580	5.580
Water [%]	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Si concentration from soil [mg Si/ g soil]	0.0016	0.0031	0.0044	0.0060	0.0083	0.0100	0.0136	0.0136	0.0146
Si concentration from soil [µg Si/ g soil]	1.62	3.06	4.37	6.01	8.29	10.04	13.57	13.62	14.55
ID: HS_3									
Calibration curve	CC3	CC3	CC3	CC3	CC3	CC3	CC3	CC3	CC3
Treatment:	U	U	U	U	U	U	U	U	U
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.114	0.161	0.2	0.252	0.342	0.408	0.493	0.526	0.574
Concentration in solution [mg/L]	0.069	0.141	0.200	0.279	0.419	0.521	0.653	0.704	0.778
Dilution 2,5 times [mg/L]	0.173	0.352	0.500	0.698	1.048	1.304	1.632	1.760	1.945
mg Si in 1 L solution	0.00017	0.00035	0.00050	0.00070	0.00105	0.00130	0.00163	0.00176	0.00195
Si in 50 ml	0.0087	0.0173	0.0240	0.0328	0.0482	0.0587	0.0718	0.0757	0.0817
Weight [g]	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850
Water [%]	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Si concentration from soil [mg Si/ g soil]	0.0015	0.0029	0.0041	0.0056	0.0082	0.0100	0.0123	0.0129	0.0140
Si concentration from soil [µg Si/ g soil]	1.48	2.95	4.11	5.61	8.24	10.03	12.28	12.93	13.97
ID: HS_4									
Calibration curve	CC4	CC4	CC4	CC4	CC4	CC4	CC4	CC4	CC4
Treatment:	U	U	U	U	U	U	U	U	U

Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.155	0.159	0.209	0.255	0.299	0.342	0.419	0.417	0.567
Concentration in solution [mg/L]	0.139	0.146	0.226	0.300	0.370	0.457	0.563	0.559	0.800
Dilution 2,5 times [mg/L]	0.348	0.364	0.565	0.749	0.926	1.143	1.407	1.399	2.000
mg Si in 1 L solution	0.00035	0.00036	0.00056	0.00075	0.00093	0.00114	0.00141	0.00140	0.00200
Si in 50 ml	0.0174	0.0179	0.0271	0.0352	0.0426	0.0572	0.0689	0.0671	0.0940
Weight [g]	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850
Water [%]	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Si concentration from soil [mg Si/ g soil]	0.0030	0.0031	0.0046	0.0060	0.0073	0.0098	0.0118	0.0115	0.0161
Si concentration from soil [µg Si/ g soil]	2.98	3.05	4.63	6.02	7.28	9.77	11.78	11.48	16.07

Si release of F1 HS during dissolution experiments:

ID: HSF1_1

Calibration curve	CC9	CC9	CC9	CC9	CC9	CC9	CC9	CC9	CC9
Treatment:	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.371	0.512	0.59	0.647	0.777	0.851	0.864	0.809	0.895
Concentration in solution [mg/L]	0.506	0.774	0.923	1.031	1.278	1.419	1.443	1.339	1.502
Dilution 5 times [mg/L]	2.532	3.872	4.613	5.155	6.390	7.093	7.217	6.694	7.511
mg Si in 1 L solution	0.00253	0.00387	0.00461	0.00515	0.00639	0.00709	0.00722	0.00669	0.00751
Si in 50 ml	0.1266	0.1897	0.2214	0.2423	0.2939	0.3192	0.3175	0.2879	0.3155
Weight [g]	5.810	5.810	5.810	5.810	5.810	5.810	5.810	5.810	5.810
Water [%]	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Si concentration from soil [mg Si/ g soil]	0.0218	0.0327	0.0381	0.0417	0.0506	0.0549	0.0547	0.0495	0.0543
Si concentration from soil [µg Si/ g soil]	21.79	32.66	38.11	41.70	50.59	54.94	54.65	49.54	54.30

HSF1_2

Calibration curve	CC13	CC13	CC13	CC13	CC13	CC13	CC13	CC13	CC13
Treatment:	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.451	0.401	0.427	0.51	0.515	0.576	0.586	0.577	0.605
Concentration in solution [mg/L]	0.742	0.646	0.696	0.855	0.864	0.981	1.001	0.983	1.037
Dilution 5 times [mg/L]	3.708	3.229	3.478	4.274	4.322	4.907	5.003	4.917	5.185
mg Si in 1 L solution	0.00371	0.00323	0.00348	0.00427	0.00432	0.00491	0.00500	0.00492	0.00519
Si in 50 ml	0.1854	0.1582	0.1670	0.2009	0.1988	0.2208	0.2201	0.2114	0.2178
Weight [g]	5.580	5.580	5.580	5.580	5.580	5.580	5.580	5.580	5.580
Water [%]	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Si concentration from soil [mg Si/ g soil]	0.0332	0.0284	0.0299	0.0360	0.0356	0.0396	0.0394	0.0379	0.0390
Si concentration from soil [µg Si/ g soil]	33.23	28.35	29.92	36.00	35.63	39.57	39.45	37.89	39.03

ID: HSF1_3

Calibration curve	CC14	CC14	CC14	CC14	CC14	CC14	CC14	CC14	CC14
Treatment:	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.519	0.431	0.438	0.459	0.458	0.477	0.489	0.555	0.577
Concentration in solution [mg/L]	0.837	0.669	0.682		0.720	0.757	0.780	0.906	0.949
Dilution 5 times [mg/L]	4.187	3.343	3.410	0.000	3.602	3.784	3.899	4.532	4.743
mg Si in 1 L solution	0.00419	0.00334	0.00341	0.00000	0.00360	0.00378	0.00390	0.00453	0.00474
Si in 50 ml	0.2093	0.1638	0.1637	0.0000	0.1657	0.1703	0.1716	0.1949	0.1992
Weight [g]	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850
Water [%]	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Si concentration from soil [mg Si/ g soil]	0.0358	0.0280	0.0280	0.0000	0.0283	0.0291	0.0293	0.0333	0.0341
Si concentration from soil [µg Si/ g soil]	35.79	28.00	27.98	0.00	28.32	29.11	29.33	33.31	34.05

ID: HSF1_4									
Calibration curve	CC11	CC11	CC11	CC11	CC11	CC16	CC17	CC18	CC19
Treatment:	F1	F1	F1	F1	F1	F1	F1	F1	F1
Time [min]	F1	F1	F1	F1	F1	F2	F3	F4	F5
Adsorption	5	30	60	120	300	600	1260	1440	1680
Concentration in solution [mg/L]	0.397	0.422	0.457	0.513	0.554	0.676	0.665	0.638	0.663
Dilution 5 times [mg/L]	0.530	0.568	0.623	0.710	0.773	0.947	0.930	0.889	0.927
mg Si in 1 L solution	2.648	2.842	3.114	3.548	3.866	4.733	4.649	4.445	4.634
Si in 50 ml	0.00265	0.00284	0.00311	0.00355	0.00387	0.00473	0.00465	0.00444	0.00463
Weight [g]	0.1324	0.1393	0.1495	0.1668	0.1778	0.2130	0.2046	0.1911	0.1946
Water [%]	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850
Si concentration from soil [mg Si/ g soil]	0.0226	0.0238	0.0255	0.0285	0.0304	0.0364	0.0350	0.0327	0.0333
Si concentration from soil [µg Si/ g soil]	22.63	23.81	25.55	28.50	30.40	36.40	34.97	32.67	33.27

Si release of F2 HS during dissolution experiments:

ID: HSF2_1									
Calibration curve	CC7	CC7	CC7	CC7	CC7	CC8	CC8	CC8	CC8
Treatment:	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.459	0.48	0.587	0.638	0.689	0.861	0.93	0.903	0.897
Concentration in solution [mg/L]	0.679	0.718	0.916	1.010	1.104	1.288	1.400	1.356	1.346
Dilution 5 times [mg/L]	3.394	3.588	4.578	5.050	5.522	6.439	6.999	6.780	6.731
mg Si in 1 L solution	0.00339	0.00359	0.00458	0.00505	0.00552	0.00644	0.00700	0.00678	0.00673
Si in 50 ml	0.1697	0.1758	0.2197	0.2373	0.2540	0.2898	0.3080	0.2915	0.2827
Weight [g]	5.810	5.810	5.810	5.810	5.810	5.810	5.810	5.810	5.810
Water [%]	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Si concentration from soil [mg Si/ g soil]	0.0292	0.0303	0.0378	0.0409	0.0437	0.0499	0.0530	0.0502	0.0487

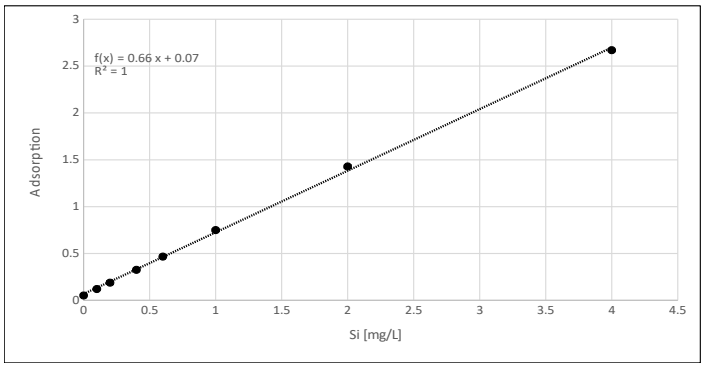
Si concentration from soil [µg Si/ g soil]	29.21	30.26	37.82	40.85	43.72	49.87	53.00	50.18	48.66
ID: HSF2_2									
Calibration curve	CC19	CC19	CC19	CC19	CC19	CC19	CC19	CC19	CC19
Treatment:	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.551	0.643	0.689	0.74	0.833	0.883	0.999	1.035	1.027
Concentration in solution [mg/L]	0.804	0.934	1.007	1.089	1.237	1.317	1.502	1.559	1.546
Dilution 10 times [mg/L]	8.038	9.338	10.072	10.885	12.368	13.166	15.016	15.590	15.463
mg Si in 1 L solution	0.00804	0.00934	0.01007	0.01089	0.01237	0.01317	0.01502	0.01559	0.01546
Si in 50 ml	0.4019	0.4576	0.4834	0.5116	0.5689	0.5925	0.6607	0.6704	0.6494
Weight [g]	5.810	5.810	5.810	5.810	5.810	5.810	5.810	5.810	5.810
Water [%]	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Si concentration from soil [mg Si/ g soil]	0.0692	0.0788	0.0832	0.0881	0.0979	0.1020	0.1137	0.1154	0.1118
Si concentration from soil [µg Si/ g soil]	69.18	78.76	83.21	88.06	97.93	101.97	113.72	115.38	111.78
ID: HSF2_3									
Calibration curve	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21	CC21
Treatment:	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.551	0.643	0.689	0.74	0.833	0.883	0.999	1.035	1.027
Concentration in solution [mg/L]	0.804	0.934	1.007	1.089	1.237	1.317	1.502	1.559	1.546
Dilution 5 times [mg/L]	4.019	9.338	10.072	10.885	12.368	13.166	15.016	15.590	15.463
mg Si in 1 L solution	0.00402	0.00934	0.01007	0.01089	0.01237	0.01317	0.01502	0.01559	0.01546
Si in 50 ml	0.2010	0.4576	0.4834	0.5116	0.5689	0.5925	0.6607	0.6704	0.6494
Weight [g]	5.810	5.810	5.810	5.810	5.810	5.810	5.810	5.810	5.810
Water [%]	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Si concentration from soil [mg Si/	0.0346	0.0788	0.0832	0.0881	0.0979	0.1020	0.1137	0.1154	0.1118

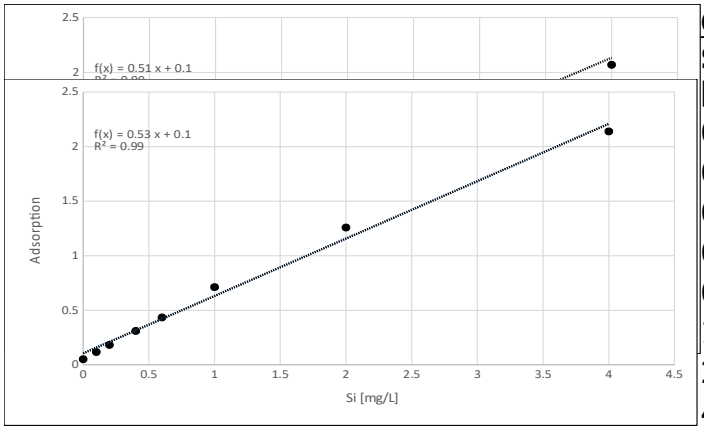
g soil]									
Si concentration from soil [µg Si/ g soil]	34.59	78.76	83.21	88.06	97.93	101.97	113.72	115.38	111.78
ID: HSF2_4									
Calibration curve	CC23	CC23	CC23	CC23	CC23	CC23	CC23	CC23	CC23
Treatment:	F2	F2	F2	F2	F2	F2	F2	F2	F2
Time [min]	5	30	60	120	300	600	1260	1440	1680
Adsorption	0.477	0.474	0.566	0.619	0.727	0.827	0.847	0.852	0.903
Concentration in solution [mg/L]	0.720	0.714	0.872	0.963	1.149	1.320	1.355	1.363	1.451
Dilution 5 times [mg/L]	3.598	3.572	4.362	4.816	5.743	6.601	6.773	6.816	7.253
mg Si in 1 L solution	0.00360	0.00357	0.00436	0.00482	0.00574	0.00660	0.00677	0.00682	0.00725
Si in 50 ml	0.1799	0.1750	0.2094	0.2264	0.2642	0.2971	0.2980	0.2931	0.3046
Weight [g]	5.810	5.810	5.810	5.810	5.810	5.810	5.810	5.810	5.810
Water [%]	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Si concentration from soil [mg Si/ g soil]	0.0310	0.0301	0.0360	0.0390	0.0455	0.0511	0.0513	0.0504	0.0524
Si concentration from soil [µg Si/ g soil]	30.96	30.13	36.03	38.96	45.47	51.13	51.29	50.44	52.43

Calibration curves (CC):

CC1

Standard Si [mg/L]	Adsorption
0	0.052
0.1	0.121
0.2	0.189
0.4	0.326
0.6	0.467
1	0.75
2	1.429
4	2.67



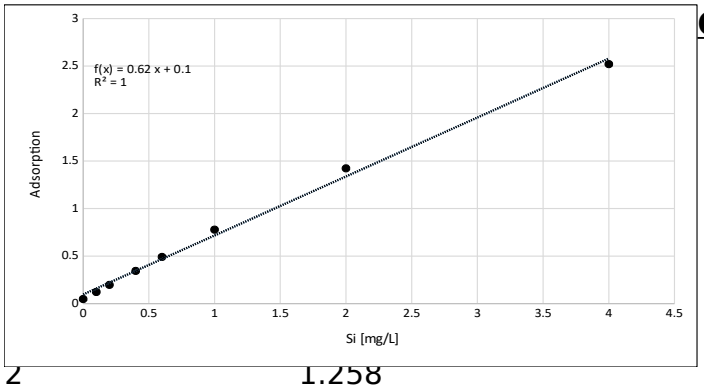


CC2:

Standard Si [mg/L]	Adsorption
0	0.054
0.1	0.123
0.2	0.19
0.4	0.326
0.6	0.465
1	0.735
2	1.411
4	2.63

CC3

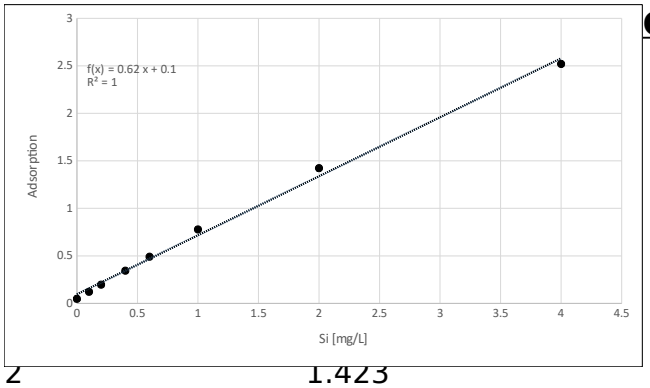
Standard Si [mg/L]	Adsorption
0	0.046
0.1	0.111
0.2	0.175
0.4	0.302
0.6	0.424
1	0.661
2	1.212
4	2.07



CC4

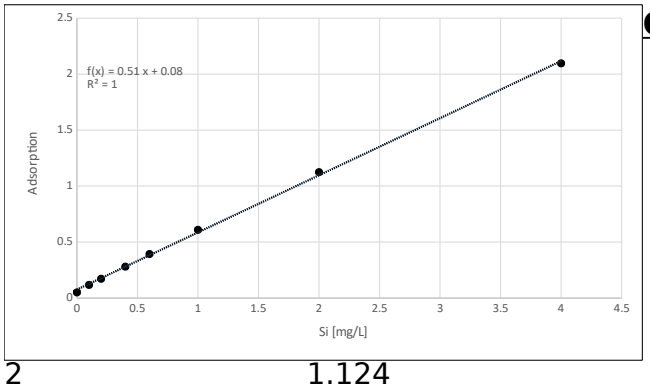
2	1.258

4 2.139



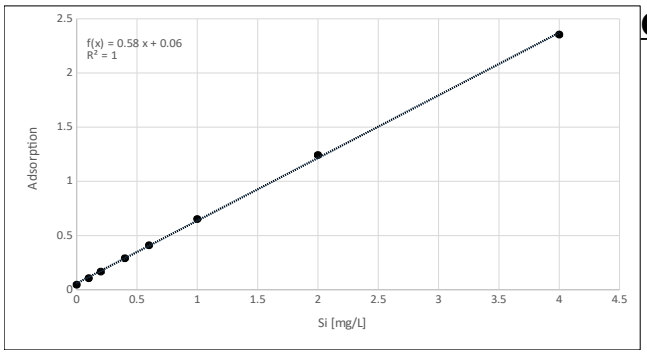
CC5

2 1.423
4 2.52



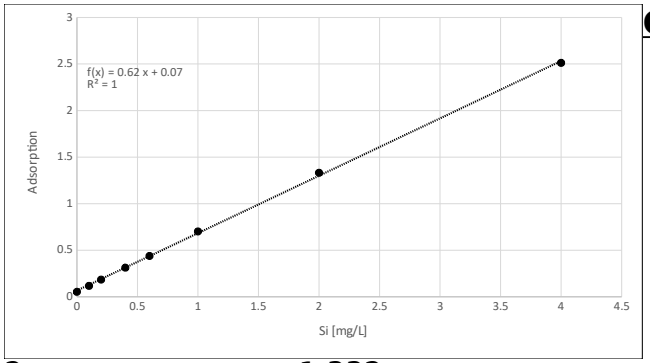
CC6

2 1.124
4 2.096



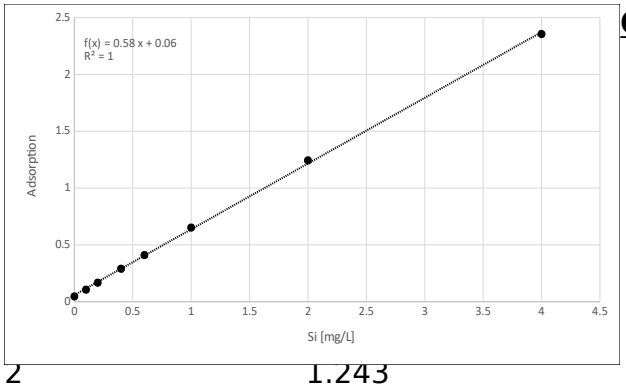
CC7

2 1.243
4 2.355



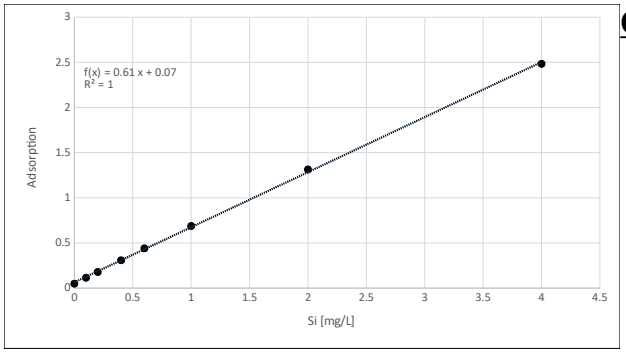
CC8

2 1.332
4 2.512



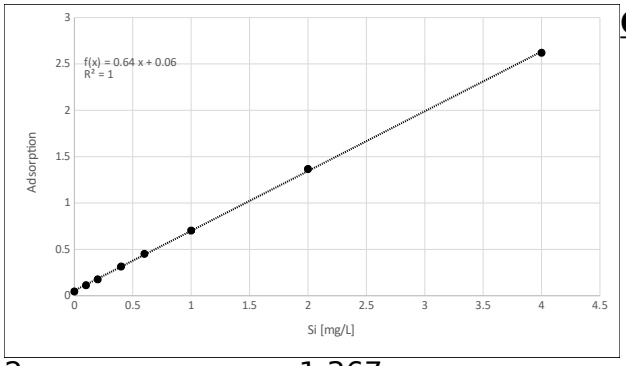
CC9

2	1.243
4	2.355



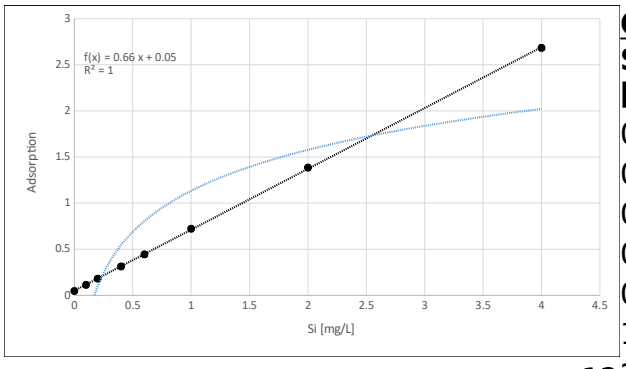
CC10

2	1.314
4	2.483



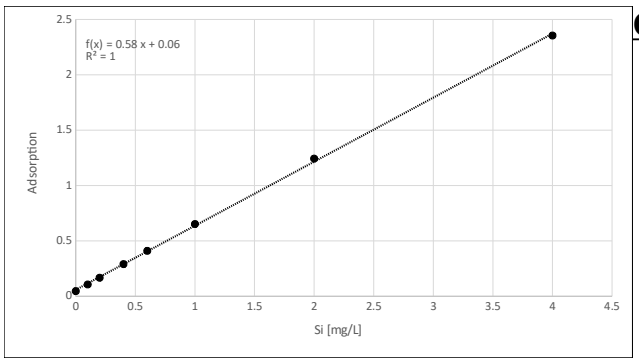
CC11

2	1.367
4	2.621



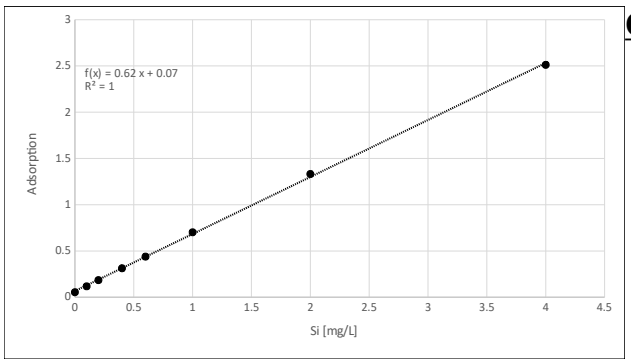
CC12

Standard Si [mg/L]	**Adsorption**
0	0.047
0.1	0.114
0.2	0.181
0.4	0.313
0.6	0.444
1	0.722
2	1.385
4	2.683



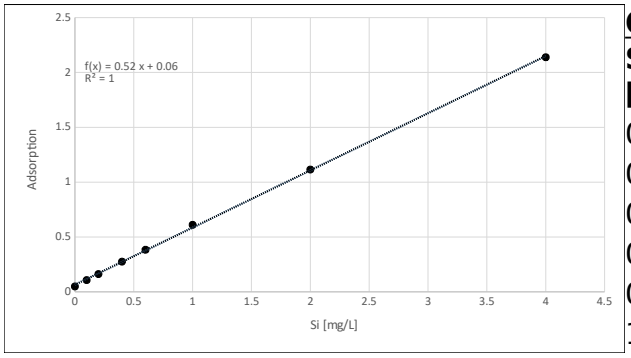
CC13

2	1.243
4	2.355



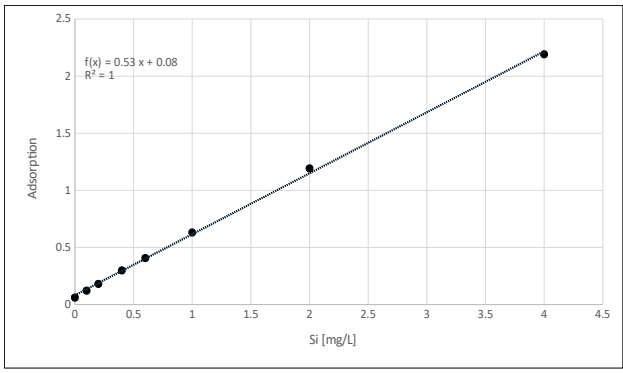
CC14

2	1.332
4	2.512



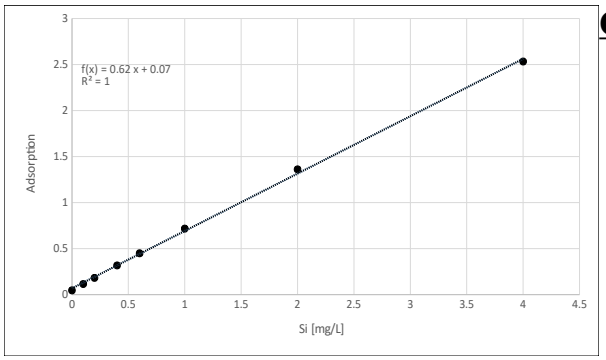
CC15

Standard Si [mg/L]	Adsorption
0	
0.1	
0.2	
0.4	
0.6	
1	
2	
4	



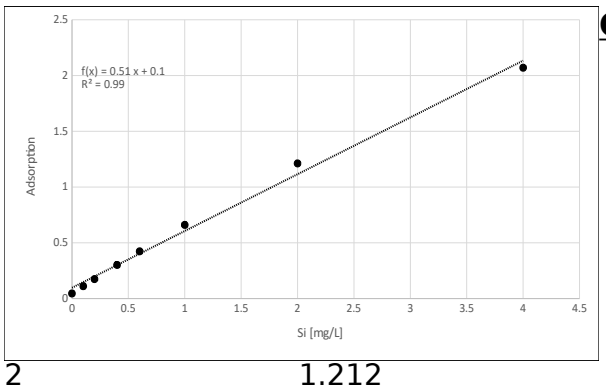
CC16

Standard Si [mg/L]	Adsorption
0	0.061
0.1	0.122
0.2	0.181
0.4	0.299
0.6	0.407
1	0.631
2	1.192
4	2.191



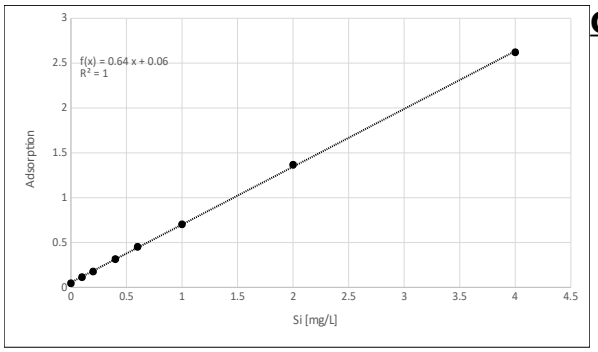
CC17

2 1.361
4 2.533



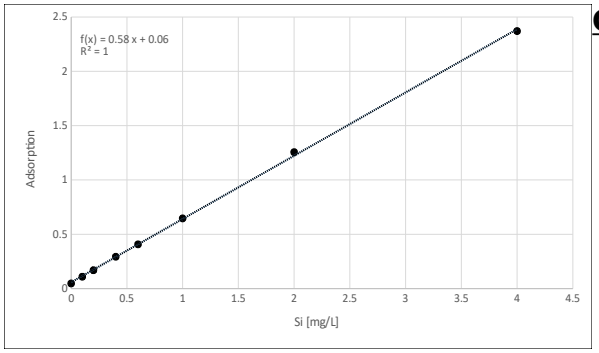
CC18

2 1.212
4 2.07



CC19

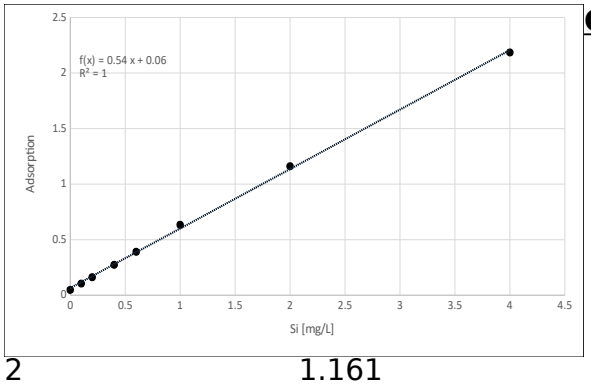
2 1.367
4 2.621



CC20

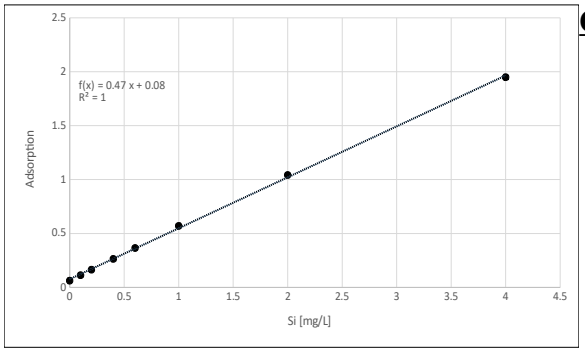
2 1.256

4 2.371



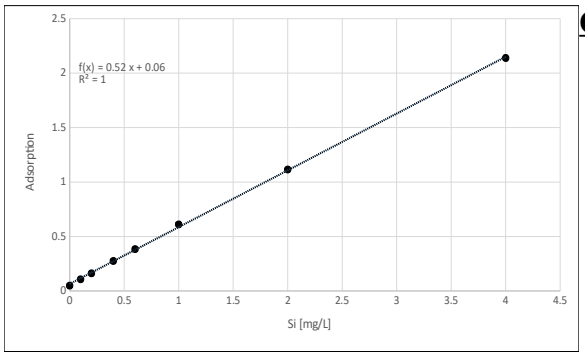
CC21

2 1.161
4 2.185



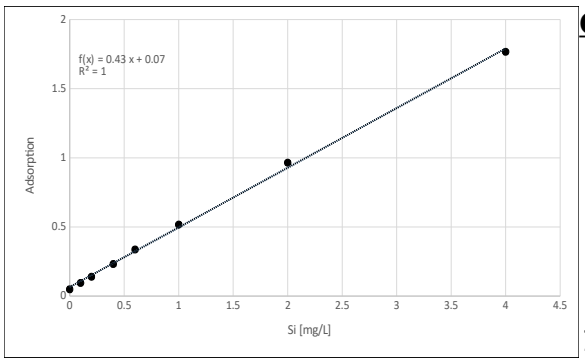
CC22

2 1.042
4 1.949



CC23

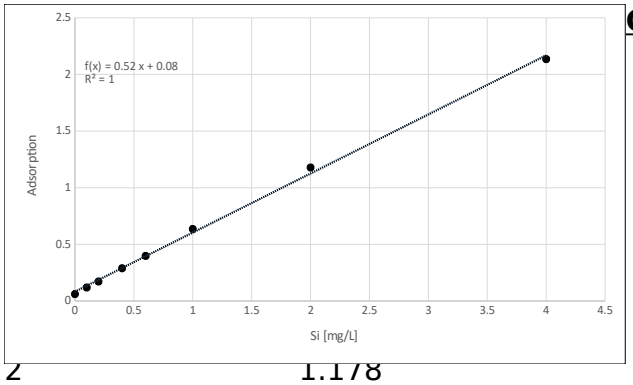
2 1.115
4 2.139



CC24

127

0.6	0.337
1	0.517
2	0.965
4	1.767



CC25

2	1.178
4	2.135

Results of statistical analysis using R:

Oil palm topsoil:

```
Response: Si
                Chisq Df Pr(>Chisq)
Treatment       18.758  2  8.447e-05 ***
Time           125.177  1  < 2.2e-16 ***
Treatment:Time  21.605  2  2.035e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1


Treatment Time lsmean   SE df lower.CL upper.CL .group
 Unburned   611   3.33 5.47  6    -14.6     21.2  a
 Moderate   611  26.54 5.47  8     10.1     43.0  ab
 Severe     611  35.84 5.47  6     17.9     53.7   b

Degrees-of-freedom method: containment
ConfPlot-IDence level used: 0.95
Conf-level adjustment: sidak method for 3 estimates
P value adjustment: tukey method for comparing a family of 3 estimates
significance level used: alpha = 0.05
```

Oil palm litter:

```
Response: Si
                Chisq Df Pr(>Chisq)
Treatment      11.448  2   0.003267 **
Time           15.762  1  7.184e-05 ***
Treatment:Time 21.416  2  2.236e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Treatment Time lsmean   SE df lower.CL upper.CL .group
 Unburned   611   32.2 99.3  6     -293      357  a
 Moderate   611  356.5 99.3  8       58      655  ab
 Severe     611  495.3 99.3  6      170      821   b


Degrees-of-freedom method: containment
Confidence level used: 0.95
Conf-level adjustment: sidak method for 3 estimates
P value adjustment: tukey method for comparing a family of 3 estimates
significance level used: alpha = 0.05



Treatment Time lsmean   SE df lower.CL upper.CL .group
 Unburned   611   32.2 99.3  6     -293      357  a
 Moderate   611  356.5 99.3  8       58      655   b
 Severe     611  495.3 99.3  6      170      821   b

Degrees-of-freedom method: containment
Confidence level used: 0.95
Conf-level adjustment: sidak method for 3 estimates
P value adjustment: tukey method for comparing a family of 3 estimates
significance level used: alpha = 0.14
```

Forest topsoil:

```
Response: Si
                Chisq Df Pr(>Chisq)
Treatment      33.7530  2  4.684e-08 ***
Time           35.5679  1  2.463e-09 ***
Treatment:Time  5.6404  2    0.05959 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1


Treatment Time lsmean   SE df lower.CL upper.CL .group
 Unburned   611   9.81 6.55  6    -11.6     31.2  a
 Severe     611  50.73 6.55  6     29.3     72.2   b
 Moderate   611  54.54 6.55  8     34.9     74.2   b

Degrees-of-freedom method: containment
Confidence level used: 0.95
Conf-level adjustment: sidak method for 3 estimates
P value adjustment: tukey method for comparing a family of 3 estimates
significance level used: alpha = 0.05
```

Forest litter:

```
Response: Si
                Chisq Df Pr(>Chisq)
Treatment      12.074  2   0.002389 **
Time           55.053  1  1.173e-13 ***
Treatment:Time 25.749  2  2.563e-06 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Treatment Time lsmean   SE df lower.CL upper.CL .group
 Unburned   611   17.8 51.8  6   -151.8      187  a
 Moderate   611  191.8 51.8  8     36.2      347  ab
 Severe     611  265.7 51.8  6     96.2      435   b
```

```
Degrees-of-freedom method: containment
Confidence level used: 0.95
Conf-level adjustment: sidak method for 3 estimates
P value adjustment: tukey method for comparing a family of 3 estimates
significance level used: alpha = 0.05


cld(result, alpha = 0.12, Letters = letters, adjust = "tukey")
 Treatment Time lsmean   SE df lower.CL upper.CL .group
 Unburned   611   17.8 51.8  6   -151.8      187  a
 Moderate   611  191.8 51.8  8     36.2      347   b
 Severe     611  265.7 51.8  6     96.2      435   b

Degrees-of-freedom method: containment
Confidence level used: 0.95
Conf-level adjustment: sidak method for 3 estimates
P value adjustment: tukey method for comparing a family of 3 estimates
significance level used: alpha = 0.12
```

Untreated topsoil from forest and oil palm plantation:

```
Response: Si
           Chisq Df Pr(>Chisq)
Plot       3.9827  1    0.04597 *
Time      17.0341  1  3.672e-05 ***
Plot:Time  0.3249  1    0.56868
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Untreated litter from forest and oil palm plantation:

```
Response: Si

            Chisq Df Pr(>Chisq)
Plot       0.9026  1     0.3421
Time      35.7422  1  2.252e-09 ***
Plot:Time  2.5719  1     0.1088
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

HSU:

```
Response: Si
        Df    Chisq Pr(>Chisq)
ID       3   0.7477     0.8619
Time     1 183.2553     <2e-16 ***
ID:Time  3   0.2121     0.9756
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

ID  Time lsmean    SE df lower.CL upper.CL .group
 HS1  611   7.76 0.583 28     6.21     9.32  a
 HS3  611   7.83 0.583 28     6.28     9.38  a
 HS2  611   7.84 0.583 28     6.29     9.39  a
 HS4  611   8.39 0.583 28     6.84     9.94  a

Confidence level used: 0.95
Conf-level adjustment: sidak method for 4 estimates
P value adjustment: tukey method for comparing a family of 4 estimates
significance level used: alpha = 0.5
```

HSF1:

```
Response: Si
        Df   Chisq Pr(>Chisq)
ID       3 33.5955  2.412e-07 ***
Time     1 32.2268  1.372e-08 ***
ID:Time  3  5.0404     0.1689
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
> library(multcompView)
> library(lsmeans)
>
> result= lsmeans(model2, ~ ID*Time)
>
> cld(result, alpha = 0.5, Letters = letters, adjust = "tukey")
 ID  Time lsmean   SE df lower.CL upper.CL .group
 HS2  611   29.8 1.71 28     25.3     34.3  a
 HS3  611   33.3 1.71 28     28.8     37.8   b
 HS4  611   35.4 1.71 28     30.8     39.9   b
 HS1  611   43.3 1.71 28     38.7     47.8    c

Confidence level used: 0.95
Conf-level adjustment: sidak method for 4 estimates
P value adjustment: tukey method for comparing a family of 4 estimates
significance level used: alpha = 0.5
```

HSF2:

```
Response: Si
        Df   Chisq Pr(>Chisq)
ID       3 744.958  < 2.2e-16 ***
Time     1  63.083  1.981e-15 ***
ID:Time  3  25.567  1.175e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
> library(multcompView)
> library(lsmeans)
>
> result= lsmeans(model2, ~ ID*Time)
>
> cld(result, alpha = 0.5, Letters = letters, adjust = "tukey")
 ID  Time lsmean  SE df lower.CL upper.CL .group
 HS4  611   30.1 1.8 28     25.3     34.9  a
 HS1  611   41.3 1.8 28     36.5     46.1   b
 HS2  611   42.0 1.8 28     37.3     46.8   b
 HS3  611   93.5 1.8 28     88.7     98.3    c

Confidence level used: 0.95
Conf-level adjustment: sidak method for 4 estimates
P value adjustment: tukey method for comparing a family of 4 estimates
significance level used: alpha = 0.5
```

Eigenständigkeitserklärung

Hiermit versichere ich, dass ich die vorliegende Arbeit selbständig verfasst habe und alle verwendeten Quellen und Hilfsmittel in der Arbeit angegeben sind. Weiterhin stimme ich der Überprüfung dieser Arbeit mittels einer Antiplagiatssoftware zu. Diese Arbeit wurde noch nicht in einem anderen Studiengang als Prüfungsleistung eingereicht.

_____

Ort, Datum Unterschrift