



Si transfers during Archean weathering processes traced by silicon isotopes and Ge/Si ratios

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Weathering conditions in the Mesoarchean are poorly constrained. Recent advances in analytical capabilities have added Si isotopes and Ge/Si ratios to the repertoire of tracers used in the study of soil formation processes: neoformation of secondary clay minerals is associated with large Si isotope and Ge/Si fractionation in response to desilication processes and the weathering degree [1, 2, 3, 4]. Here we combine Si isotopes and Ge/Si ratios of a Mesoarchean paleosol (~2.95 Ga) and of nearly coeval but younger shales as proxies of weathering processes and Si mass transfer at the early Earth's surface. The paleosol is developed on andesite and shows a well defined mineralogical and chemical differentiation. In a first step, similar to modern soils, neoformation of secondary clay minerals in the paleosol was associated with fractionation of Si isotopes and Ge/Si ratios in response to chemical weathering degree and soil desilication. In a second step, the loss of Fe(II)-rich minerals, likely Fe-rich smectites, due to low pO_2 conditions produced additional control on Si and Ge mobilities. Opposite fractionation behaviors are observed: products of desilication acted as ^{28}Si and Ge sink while the leaching of Fe(II)-rich minerals released ^{28}Si and Ge to soil solutions. Furthermore, the shales deposited immediately after the paleosol display $\delta^{30}\text{Si}$ and Ge/Si compositions which may be explained as mixtures of the recognized Archean paleosols components. Their recording within the sedimentary pile suggests that the observed weathering-induced desilication might have been widely effective during the Mesoarchean as well as Fe(II)-rich minerals leaching in a lesser extent and pointing out these processes as determinant in the Si transfers from continents to hydrosphere.

[1] Kurtz et al., (2002) *Geochim. Cosmochim. Acta* **66**, 1525-1537

[2] Ziegler et al., (2005) *Geochim. Cosmochim. Acta* **69**, 4597-4610.

[3] Opfergelt et al., (2010) *Geochim. Cosmochim. Acta* **74**, 225-240.

[4] Steinhofel et al., (2011) *Chem. Geol.* **286**, 280-289.