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Use of silicon isotopes in marine and continental systems to study the origin, fate and fluxes of silicon

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The measurement of natural silicon isotopic signatures (d30Si) has been widely developed since the advent of MC-ICP-MS instruments in the late 90's which have facilitating both precision of, and access to, d30Si data. Some studies have already modelled global marine d30Si (paleo-)variations, but the modern data from rivers and ocean are still relatively scarce to validate the outputs of these models. This prevents the use of d30Si proxy for quantitative paleo-reconstructions so far. Here we will present some examples from marine (Southern Ocean) and continental systems (soils and plants, lakes and rivers) with the goal to improve the understanding and calibration of this relatively new isotopic proxy. Isotopic signature of the source and extent of isotopic fractionation are the two key parameters that need to be assessed in this regard, and an overview of our current knowledge and caveats will be presented. For instance, estimates of fractionation factor by diatoms range from 0.8 to 1.9 pmil. Clay formation, uptake by plants and adsorption processes favour also the preferential mobilization of light Si isotope with a fractionation factor in the same order as the one of diatoms. Such overlaps on the potential induced isotopic shifts add difficulty in using the proxy to decipher among the different processes.

Nevertheless, we will show that when studied on well constrained systems (at the local / regional scale), silicon isotopes can be successfully applied to study the silicon cycle by providing an additional useful constrain. In particular Si source and fate can be identified, Si budget closed, and/or (non-)equilibrium status of the system determined.

Finally, some perspectives will be presented for d30Si, especially in the context of the on-going GEOTRACES programme which will shape the international actions on trace elements and isotopes in the ocean for the next decade.