

Influence of cyanide on granite weathering

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Availability of nutrients in the glacier forefield is usually very low. Mobilization of nutrients from rock through weathering processes plays an important role to overcome this limitation [1]. Microorganisms and plants modify their local environment by various exudates including cyanide [2], which is a crucial agent during the initial period of colonization and soil formation.

To elucidate the effect of cyanide on dissolution of granite minerals, the samples were collected from the Damma glacier area (Central Alps, Switzerland) at approximately 2,500 m a.s.l. After crushing and sieving, materials with size fraction <63 μm (surface area=1.55 m^2/g) were selected for abiotic dissolution experiment. Batch experiments were carried out with a solid/liquid ratio of 10 g/L in the absence or presence of cyanide under oxic conditions at 22 ± 1 °C, $I=0.01$, pH range of 5-7 for 24 hours.

Among the elements released from granite, enhanced Fe concentrations were observed in presence of cyanide. This applies particularly with increasing pH, suggesting that deprotonated cyanide becomes more important for the formation of Fe complexes. Iron cyanide complexes presence at high concentrations in particular at pH above 6 [3] and allow high concentrations of dissolved Fe. The dissolved Al concentrations were considerably lower than those of Fe due to precipitation of secondary phases (e.g. gibbsite and kaolinite).

[1] Bernasconi *et al.* (2008) *MinMag* **72**, 19-22. [2] Frey *et al.* (2010) *AEM* **76**, 4788-4796. [3] Meeussen *et al.* (1992) *ES&T* **26**, 1832-1838.

Accretion and initial differentiation of the Earth

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A large number of moon- to Mars-sized planetary embryos with different metal/silicate/volatile ratios are believed to have formed around the young sun in ~ 1 M.yr. As Earth accreted from such embryos through a succession of impacts, the metallic core segregated and there was some loss of the most volatile elements. The chemical and isotopic composition of silicate Earth provides most evidence for these processes. Depletions of silicate Earth, relative to primitive meteorites, in elements known to have entered the core (e.g. Mo, W, Ni, Co) place constraints on the physical conditions of accretion. Short and long-lived chronometers (^{182}Hf - ^{182}W , $^{238,235}\text{U}$ - $^{206,207}\text{Pb}$, ^{205}Pb - ^{205}Tl , ^{107}Pd - ^{107}Ag) enable estimates of the timing of core formation, the influence of the moon-forming impact and the history of volatile accretion to the Earth. If we begin with the assumptions that core segregation was continuous during accretion and that metal and silicate fully equilibrated, simultaneous consideration of the depletion factors of a large number of elements in silicate Earth lead to the following general conclusions: (1) The average pressure of core segregation on Earth was high >30 GPa, implying depths of >800 km. (2) Earth began as a small, strongly reduced body and became more oxidised as it grew. (3) Si ($\sim 5\%$) and S ($\sim 2\%$) are major components of the "light" element in Earth's core. Relaxing the assumption of full equilibration (ie allowing for the addition of metal to the core without reaction with the mantle) and allowing for the influence of S and Si on partitioning does not significantly alter these conclusions.

The ^{182}Hf - ^{182}W age of Earth's core [1], may be used in combination with other short- and long-lived radioactive systems to show (1) Moderately volatile elements were predominantly added to Earth towards the end of accretion [2] and (2) The fractionation of U from Pb at ~ 100 M.yr after the origin of the solar system is consistent with Pb extraction in a small amount of core material added during the moon-forming giant impact.

[1] Kleine, T., Munker, C., Mezger, K., & Palme, H., Rapid accretion and early core formation on asteroids and the terrestrial planets from Hf-W chronometry. *Nature* **418** (6901), 952-955 (2002). [2] Schönbächler, M., Carlson, R.W., Horan, M.F., Mock, T.D., & Hauri, E.H., Heterogeneous accretion and the moderately volatile element budget of Earth. *Science* **328**, 884-887 (2010).