Archean mantle heterogeneities revealed by Hf-Nd isotope systematics of the 3.33 Ga Commondale komatiites

J. ELIS HOFFMANN[1,2] AND ALLAN H. WILSON[3]

[1]Universität zu Köln, Germany; hoffmaj1@uni-koeln.de
[2]Steinmann-Institut, Universität Bonn, Germany
[3]University of Witwatersrand, Johannesburg, South Africa

The modern Earth's mantle is strongly heterogeneous, bearing ancient depleted portions that escaped homogenization. For the Archean depleted mantle, the degree of heterogenity is comparably unconstrained. Powerful tools to investigate the degree of depletion of the mantle at a given time are the radiogenic ^{176}Lu-^{176}Hf and ^{147}Sm-^{143}Nd decay systems that can be applied on mafic and ultramafic rocks that directly tapped depleted mantle sources.

Here we report the first ultra-depleted mantle reservoirs for the Palaeoarchean tapped by the extraordinary well preserved 3.33 Ga Commandale komatiites [1] from the eastern Kaapvaal Craton, South Africa. The best preserved samples yield identical Lu-Hf and Sm-Nd isochron ages of 3334 ±27 Ma (MSWD: 0.21) and 3334 ±13 Ma (MSWD: 0.76), respectively, also in agreement with the Re-Os regression age of 3393 ±440 Ma [2]. Initial εHf(t) and εNd(t) values are +6.5 to +9.2 and +1.6 to +2.4, revealing a decoupling of both isotope systems during previous melt extraction in the stability field of garnet. Moreover, a contamination with older crust during ascent can be excluded. In contrast, γOs(t) values are about chondritic, hence showing also decoupling from εNd(t) and εHf(t). This can be explained by the partition behaviour of Re-Os during mantle melting under oxidized conditions, leading to no fractionation of Re from Os in the source [3]. Primitive mantle normalized trace element patterns of the Commondale lavas show strong depletion of Nb-Ta, positive Zr-Hf, Ti and Y anomalies as well as comparably enriched LREE and Th for some samples. As alteration can be excluded here, the re-enrichment process might have been related to re-enrichment processes in an arc setting. This is supported by experimental data for the Commondale suite arguing for a hydrous mantle source [4]. Overall, the Commondale komatiites are the first reported strongly radiogenic Hf isotope compositions reported from the Palaeoarchean revealing initial εHf(t) well above the average depleted mantle at 3.3 Ga.

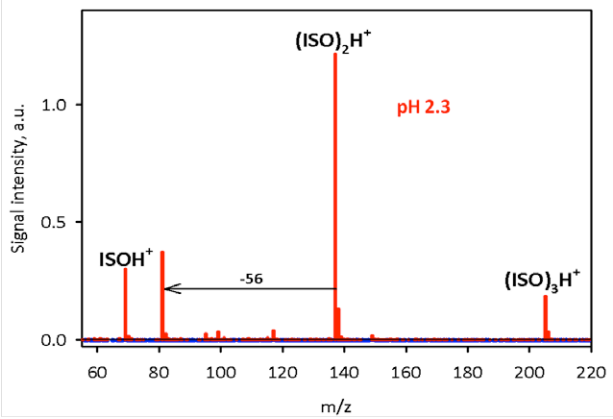
[1] Wilson and Carlson (1989) *EPSL* **96**, 89-105. [2] Wilson *et al* (2003) *Nature*, **423**, 858-861. [3] Birck and Allègre (1994) *EPSL* **124**, 139-148. [4] Barr *et al* (2009) *EPSL* **284**, 199-207.

Chemical reactions at the air-water interface in the troposphere

MICHAEL R HOFFMANN*, HIMANSHU MISHRA AND A. J. COLUSSI

Linde+Robinson Laboratory and Center for Global Environmental Science, California Institute of Technology, Pasadena, California 91125 USA
(*correspondence: mrh@caltech.edu)

An in depth investigations of chemical and physical phenomena at air-water interface are critical for understanding heterogeneous processes on cloud droplets, dew, fog, and haze aerosol. With this mind, the report that gas-phase isoprene (2-methyl buta-1,3-diene, ISO) is protonated as $ISOH^+$ and oligomerized into a dimer, $(ISO)_2H^+$, and a trimer, $(ISO)_3H^+$, during collisions with pH < 4 aqueous microdroplets during gas-droplet collisions over 50 μs. Based on these observations, determined the probability of protonation per collision as $\gamma \sim 10^{-5}$ corresponding to a process hindered by a 7 kcal mol^{-1} kinetic barrier. During the $\lambda > 305$ nm photolysis of H_2O_2 in aqueous dilute ISO solutions yields $C_{10}H_{15}OH$ species as primary products, whose formation both requires and is inhibited by O_2. A minimum of seven $C_{10}H_{15}OH$ isomers are resolved by reverse-phase high-performance liquid chromatography and detected as MH^+ (m/z = 153) and MH^+-18 (m/z = 135) signals by electrospray ionization mass spectrometry.



www.minersoc.org
DOI:10.1180/minmag.2013.077.5.8