Martian xenology

B. MARTY[1,2], K.J. MATHEW[2] AND K. MARTI[2]

[1] CRPG-CNRS, BP 20, 54501 Vandoeuvre Cedex France bmarty@crpg.cnrs-nancy.fr
[2] Dept. Chemistry & Biochemistry, UCSD, CA 92093-0317, USA mkattah@ucsd.edu & kmarti@ucsd.edu

The SNC meteorites Chassigny, ALH84001, Nakhla and the newly discovered nakhlite NWA817 and shergottites NWA480, NWA856, NWA1068 contain xenon produced by the fission of the extinct radionuclide ^{244}Pu ($T_{1/2}$ = 82 Ma). The fission gas correlates with indigenous solar-type Xe, a Martian interior component. Nakhlites and shergottites are enriched (relative to chondrites) in U, REE, and fissiogenic ^{136}Xe*, demonstrating enrichments through magmatic differentiation in closed system condition. This implies that the parent magmas did not cool down close to the surface as proposed.

The ratios (^{129}Xe/^{136}Xe)* , where ^{129}Xe* is decay product of extinct ^{129}I – ($T_{1/2}$ = 16 Ma), observed in high temperature fractions are systematically lower than expected from decay in a closed Martian mantle. The low I/Pu ratio of SNC requires early differentiation of volatile iodine with respect to refractory plutonium ≤ 35 Ma after start of solar system formation, which may represent the time of mantle-atmosphere differentiation. The computed amount of mantle Xe released into the early Martian atmosphere is ~3 orders of magnitude higher than the Xe abundance observed in the present-day atmosphere, as is the amount of ^{129}Xe* produced by the decay of ^{129}I transferred to the Martian surface, implying drastic loss of Martian atmospheric gases over several tens of Ma.

Martian "xenology" strongly suggests that mantle-crust-atmosphere evolution was earlier than that of Earth and that Mars has been a static planet for most of its history after these early episodes.

Parental magmas and crustal contamination of tholeiitic basalts as revealed by mineral major and trace element compositions

A. MARZOLI [1], F. BUSSY [2] AND F. JOURDAN [3]

[1] Section des Sciences de la Terre, Université de Genève, Switzerland (Marzoli@terre.unige.ch)
[2] Institute of Mineralogy and Geochemistry, Université de Lausanne, Switzerland (Bussy@img.unil.ch)
[3] Geosciences Azur, Université de Nice-Sophia Antipolis, France (Jourdan@unice.fr)

The Kerforne tholeiitic basalts (France, northernmost Central Atlantic magmatic province) are augite and plagioclase phyric dolerites. They have evolved compositions (MgO 7-9 wt. %), moderately enriched REE patterns, positive –$_{Sr}$ (+ 15 to +22), and –$_{Nd}$ close to 0. Optically homogeneous, large augite phenocrysts (Wo = 42-35) are characterized by high-MgO (Mg# = 85-82), high Cr_2O_3 cores (up to 0.6 wt. %) with depleted light vs. heavy REE patterns (laser ablation ICP-MS data). Augite cores probably crystallized from little evolved magmas, and suggest that primitive Kerforne tholeiites had almost flat REE patterns.

Plagioclase phenocrysts are characterized by high-An (An_{85}) rounded, resorbed cores, which are MgO-rich (~0.25-0.30 wt. %), La and Ce and particularly Y- poor. Textures and chemical compositions suggest that the high-An cores were not in equilibrium with the basaltic host-rock, but are probably xenocrysts inherited from a heavy REE depleted crustal gabbro.

In this scenario, the differentiation of Kerforne basalts is modelled starting from a parental magma calculated from augite core compositions, which undergoes fractional crystallization and assimilates a crustal melt calculated from plagioclase core compositions.