Petrological constraints on formation of the martian crust

D. BARATOUX*[1], M. MONNEREAU[1], M.J. TOPLIS[1], K. KURITA[2], H. SAMUEL[1], R. F. GARCIA[1] AND M. WIECZOREK[3]

[1]Institut de Recherche en Astrophysique et Planétologie, CNRS & Université Paul Sabatier, Toulouse III, 14. Av. Edouard Belin, 31 400 Toulouse. (*correspondance: david.baratoux@irap.omp.eu)
[2]Earthquake Research Institute, University of Tokyo, 1-1-1 Yayoi, Bunkyo-ku, Tokyo, Japan
[3]CNRS, Institut de Physique du Globe de Paris, 5, rue Thomas Mann. Université Paris Diderot, 75205 Paris Cedex 13, France.

The 4 Ga-record of Martian volcanic activity has been characterized over the last decade by various remote sensing instruments, including gamma ray spectroscopy and visible/near-infrared spectroscopy. Based on these data, the martian crust is viewed as a basalt-dominated world with limited crustal differentiation. This relatively simple situation (when compared to the Earth) may be responsible for observed trends in surface chemistry and mineralogy with age, such as an increase with time of the abundance of high-calcium pyroxene relative to that of low-calcium pyroxene. Indeed, petrogenetic modeling suggests that these trends can be explained in terms of variable degrees of partial melting of a martian mantle of constant composition [3,4], providing a quantitative estimate of the average cooling rate of the martian interior. On the other hand, further work is needed to reconcile this model with the existence of distinct geochemical mantle reservoirs inferred from the analysis of the SNC meteorites. The idea that the martian mantle has been cooling for at least the last 4 Ga, as constrained from data spanning the entire Noachian-Hesperian-Amazonian periods, has several petrological, geochemical and geophysical implications. For example, mineralogical transitions observed around 3.7 Ga may be related to minor changes in mantle temperature. Furthermore, even the oldest exposed surface rocks could be an expression of this ancient volcanism rather than being associated with a mantle overturn following the crystallization of a magma ocean. In light of these results, we also argue that the density of the martian crust should be revised to higher values, in agreement with [5]. A lower density contrast with the mantle implies a thicker crust for which a basalt-eclogite transition would appear to be very likely (at least in some regions), providing a motivation to explore mechanisms of crustal recycling and implications for the fate of heat-producing elements.

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Hydrogeochemical and isotopic characterization of the Saturnia thermal aquifer

A. BARBAGLI[1]*, F. BROGNA[1], E. GUASTALDI[1], G. LIALI[1], C. REZZA[2] AND M. TROTTA[1]

[1]CGT Center for GeoTechnologies, University of Siena, Via Vetri Vecchi, 34 - 52027 S. GiovanniValdarno, Italy. (*correspondence: barbagli.alessio@gmail.com)
[2]Corso Italia n 16,80011, Acerra, Naples Italy. (carmelarezza@yahoo.it)

The thermal area of Saturnia was discovered and visited for several centuries before the Roman Empire and is still one of the most visited thermal springs in the world. It is located in central Tuscany between the Monte Amiata and the Tuscan volcanic area to the south. Herein, we study the thermal aquifer by chemical and isotopic analyses.

At first time, chemical-physical analyses have been used to a preliminary choose between all the sampled waters. Later, some elements and compounds (Na, Ca, Mg, K, Cl, SO_4^{2-}, NO_3^-, total alkalinity, Li, Sr, B, F^-, SiO_2, CO_2, Sb, As, Se, Fe, Mn, Hg e Pb) have been analyzed ad used to classified the previously chosen samples. In particular, Lithium (according to [1]), Boron and Strotium shows that the main important host of the studied thermal water is the calcareous geological formation of "Calcare Cavernoso"; high values of Selenium, according to [2, 3], also shows the influence of volcanic fluids in the thermal anomalies of the Saturnia thermal area.

Finally, some isotopes have been analyzed (^2H; ^3H, ^3He,^4He, ^{13}C, ^{18}O, ^{86}Sr, ^{87}Sr) to obtain others important information. The isotopes in the water molecule show that the recharge area of the thermal aquifer is located some km towards north regarding to the Saturnia spring, and his residence time is greater than 30 years. The $^{87}Sr/^{86}Sr$ ratio, measured in the Saturnia thermal water, allowed distinguish the aquifer (according to [4]) from the other host of the near thermal aquifer of Mt. Amiata, sampled in Bagni San Filippo. The isolation from the surface infiltration during the underground flow of the thermal water of Saturnia has been checked by the values of $\delta^{13}C$. And by the analysis of $^3He/^4He$, sampled in a larger area, the influences of the mantle in the Saturnia thermal area has been excluded, in according to [5].

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