Evidence for volatiles on Mercury

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Several independent lines of evidence provided by MESSENGER suggest that Mercury is surprisingly rich in volatiles: (i) Gamma-ray spectroscopy reveals a high K/Th ratio in its surface regolith similar to Mars, and very much higher than the Moon [1]. (ii) Xray spectroscopy reveals 2-5% S in its surface regolith [2]. (iii) It has recognisable pyroclastic deposits around vents, requiring explosive exsolution of an unknown magmatic volatile phase in the range 3600-13,000 ppm [3]. (iv) It exhibits patches of steep-sided, flat-bottomed 'hollows' (10s of m deep and 100s of m to km wide) associated with a spectrally distinct (blue, high albedo) unit that appear to form by sublimation, or some similar process capable of dispersing material to space [4]. (v) Neutron spectrometer measurements [5] show a hydrogen-rich phase, interpreted as water-ice, within permanenently-shadowed polar craters [6].

Polar-ice (v) is probably cold-trapped from on-going cometary impacts, but (i)-(iv) are likely to reflect volatiles intrinsic to Mercury. It has been argued [7] that (i) and (ii) could result from low oxygen fugacity affecting geochemical affinities rather than demonstrating volatile-richness on a volumetric planetary scale. Nevertheless it is clear from study of volcanic vent architecture, pyroclastic deposits and hollows that migration of volatile phases from the interior to and through the surface plays a major role in sculpting Mercury' surface. We look forward to enhanced insights when Bepi Colombo achieves orbit.

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Heavy noble gases in type 3 enstatite chondrites. Implications for the Earth primordial signature and its evolution.

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Enstatite chondrites have often been proposed as possible building rocks of telluric planets and in particular of the Earth [1]. This hypothesis is based firstly on the coincidence of their respective formation zone (inner part of solar system [2]) and also on the similarity of their isotopic composition (O, N, Ni, Mo, Ru, Os, $^{53\text{-}54}$Cr…) [1]. Moreover, enstatite chondrites of type 3 in particular are the only chondrites to display close ^{142}Nd/^{144}Nd ratio to Earth [3]. Thus their study may bring information about primordial composition of the Earth concerning noble gases.

Analysis of E3s by mass spectrometry coupled to stepwise heating allows us to highlight that their primordial composition for Xe and Kr is related to phase Q. So, regarding the ubiquity of this phase, its resistance to high temperatures and also its high noble gases content, it seems appropriate to consider it is the most likely primordial signature of the Earth.

We will discuss the possibility of a terrestrial evolution starting with a phase Q composition, as nowadays, Earth's mantle and atmosphere don't display the same isotopic signature. This discrepancy can be due first to fractionation during accretion process as it has been suggested for Nd ([4]) or to post-accretionnal processes like partial loss of primary atmosphere [5] and also noble gases subduction which can have modified in the long run mantle's signature [6].

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