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Matching Martian Crustal Magnetization and Magnetic Properties of Martian Meteorites

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Detailed magnetic data is presently available on all Martian meteorites known today, except Yamato 793605, 980459 and 1075, GRV99027, NWA 1950 and 3171, i.e. 26 over 32 unpaired SNCs.

Remanent magnetization of SNCs is carried either by titanomagnetite or by pyrrhotite (or by the mixture of both). Various rock magnetic parameters and criteria have been used, together with microscopic observation, to reach these conclusions. The S ratio - the isothermal remanent magnetization (IRM) obtained after applying a 3 T field and then a back field of –0.3 T, normalized to the 3 T IRM- appears a particularly adapted parameter. It is $<$-0.95 for titanomagnetite and $>$-0.9 for pyrrhotite (Figure). Remanent coercivity is also significantly higher for pyrrhotite bearing SNCs. Titanomagnetite is the magnetic carrier in nakhlites (7 studied meteorites) whereas it is pyrrhotite in most basaltic shergottites (11 meteorites). Dhofar 378, Los Angeles, NWA480/1460 and 2046 are anomalous basaltic shergottites, as their magnetism is mainly due to titanomagnetite. A mixture of magnetite and pyrrhotite is observed in ALH84001 and LEW88516, while magnetite dominates in ALHA77005 and Chassigny.

The NRM of SNCs is not the correct analog for the highly magnetized Martian crust due to acquisition after dynamo shut down and/or non thermoremanent (TRM) acquisition process (except possibly ALH84001). It is more significant to estimate in situ NRM for Noachian rocks equivalent. to SNC by using the saturation IRMs of SNCs and the proposed value of 2 % for NRM/IRM in case of TRM in an Earth-like field for

magnetite or pyrrhotite. Taking 5 A/m for the minimal crustal NRM and a mass density of 3 leads to a minimum saturation IRM of 83 10^{-3} Am^2/kg. Ultramafic cumulates (i.e., Chassigny, ALH 84001) and lherzolitic shergottites (ALH77005, LEW88516) are too weakly magnetic (by one or two orders of magnitude: squares) to account for the crustal magnetizations, assuming magnetization in an Earth like field. Nakhlites (circles) and some basaltic shergottites (triangles) show the right intensity. The most titanomagnetite rich SNCs are MIL03346 and Los Angeles, and the most pyrrhotite-rich is NWA1068. As basaltic shergottites seems more representative of the average Martian crust, pyrrhotite should be among the candidate minerals for the magnetized Noachian crust.