NEW PERSPECTIVES FROM THE NAKHLITES MAGNETIC SIGNATURE

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Introduction: During the last years, a systematic investigation of the magnetic signature of stony meteorites has been started [1]. Detailed studies of the Martian meteorites (SNC) by magnetic methods deepened significantly our knowledge about their magnetic record and magneto-mineralogy [2,3,4]. New light was shed in this way on the formation of the SNC as well on surface forming processes such as impacts on Mars.

Investigations and results: Aim of our project is a systematic study on the magnetic signature of all Martian meteorites (SNC). Preliminary data obtained on the SNC from the NIPR collection have been reported recently [5,6,7]. The nakhlites are igneous cumulate rocks that formed in flows or shallow intrusions from basaltic magma about 1.3Gyrs ago on Mars [8]. Seven nahklites are identified presently, all with typical ejection ages of ≈11Ma and terrestrial ages ranging from around 50±20ka (Y000593) to recent (observed falls) [8]. Generally, the nakhlites are characterized by minor shock effects (<20GPa).

The paired nakhlites Y000593/749/802 have the longest residence time of all nakhlites and are therefore well suited for a detailed study of the influence of terrestrial weathering effects under Antarctic conditions on the magnetic record. For example, a significant trend of decreasing values of magnetic susceptibility (MS) from the large Y593 (13.5kg) and Y749 (1,28kg) stones to the small Y802 (22gr) is evident and most likely reflects terrestrial weathering. A more substantiated test for the influence of terrestrial weathering and its discrimination from Martian alteration effects can be proposed based on the magnetic signature.

A new schematic model for the likely petrogenesis of the nakhlites on Mars was recently published [9]. Taking into account MS (log of mass spec. MS in 10^{-9} m^3/kg) and M_{rs} (M_{rs}: saturation magnetic remanence in 10^{-3} Am^2/kg) of all nakhlites (between 2 and 10 samples per nakhlite included in the database), there is clear evidence for a link between magnetic signature and the petrogenesis model: highest MS (3,71-3,77) and M_{rs} values (133-398) for MIL03346 and NWA817, respectively, followed by a group of low/moderate MS (3.63, 3.20, 3.30, 3.23) / low M_{rs} (73, 77.4, 89.7, 69.0) nakhlites (Y000593, Nahkla, Gov. Vald., Lafayette) and again higher MS (3.60) / M_{rs} (427) values for NWA998. Additional magnetic parameters (and magneto-mineralogy) will be included in our approach to further test and substantiate these findings.

References:

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