MÖSSBAUER SPECTROSCOPY STUDIES OF WEATHERING IN ORDINARY CHONDRITES FROM THE SAN JUAN STREWNFIELD AT THE ATACAMA DESERT

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We report the results of ^{57}Fe Mössbauer spectroscopy at room and low temperature, involving 21 meteorites collected in the Atacama Desert, northern Chile [1]. The meteorites are weathered ordinary chondrites (OC) and include the chemical groups H (12 samples) and L (9 samples).

The spectra at RT exhibit three quadrupole doublets, two attributed to Fe^{2+}, one associated to olivine and the other to pyroxene. The third is due to Fe^{3+} with hyperfine parameters typical of oxides and oxyhydroxides (e.g., ferrihydrite, small-particle goethite, lepidocrocite, akaganéite). Low temperature measurements are required to unambiguously resolve this phase. Additionally, the spectra presents six magnetic sextets, two of them associated with the primary phases Fe-Ni (kamacite/taenite) and FeS, and the others associated to oxides/oxyhydroxides: goethite, hematite and magnetite that typically show two sextets at RT.

Mössbauer spectra at low temperature exhibit a similar pattern to the RT spectra: olivine, pyroxene and six magnetic components (troilite, goethite, magnetite, hematite and kamacite/taenite). In addition, it is observed one magnetic component (not seen at RT) with an hyperfine field of 48 – 49 T with nearly the same relative area of the Fe3+ doublet observed at RT. This magnetic component identified by their hyperfine parameters as akaganéite can be associated to the magnetic splitting at low temperature of the Fe^{3+} doublet.

The Mössbauer spectral areas of Fe^{3+} components indicates that the oxidation level of the studied Atacama OC range from ~ 11% to ~ 67 %. The analysis of the ferric oxidation of the primary phases derived from the Mössbauer results shows that Fe-Ni metal and troilite as well as the ferromagnesian silicates appear to be affected by oxidation. Further, the rate of weathering of the ferromagnesian silicates is found to be nearly the same, indicating that both olivine and pyroxene are equally susceptible to oxidation.

Comparing the oxidation frequency distribution of the San Juan area with the oxidation frequency distribution of other areas of the Atacama Desert [2,3]. we can observe that San Juan area show two peaks around ~ 20% and 50 %, in contrast with the peak value ~ 55% of the samples from other areas.

Reference: [1] Gattacceca et al., 2009. MAPS 44: A75 [2] 72st Annual Meeting of the Meteoritcal Society, 2009; Nancy. Meteoritic & Planetary Science, 2009. v. 44. p. A150-A150. [3] 71st Annual Meeting of the Meteoritcal Society, 2008, Matsue. Meteoritic & Planetary Science, 2008. v. 43. p. A105-A105.