Fe-BEARING MINERALS IN WEATHERED ORDINARY CHONDRITES FROM THE ATACAMA DESERT

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Here we report the results of ^{57}Fe Mössbauer spectroscopy, involving equilibrated weathered ordinary chondrites (OC) collected in the Atacama Desert, northern Chile, that include the three chemical groups (H, L and LL). The present ^{57}Fe Mössbauer results obtained at room temperature (RT) and at liquid helium temperature (4.2 K) on 15 OC samples precise the quantity and nature of all the Fe-bearing phases recognized in previuos RT ^{57}Fe Mössbauer works [1, 2].

The degree of weathering in ordinary chondrites can be quantitatively measured using Mössbauer spectroscopy to determine the proportions of the Fe-bearing phases occurring mainly as Fe^0 in the Fe-Ni metal, Fe^{2+} in the ferromagnesian silicates and troilite, and Fe^{3+} in the terrestrial alteration products. In newly fallen equilibrated OC the amounts of Fe^0 (kamacite and taenite) and Fe^{2+} (olivine, pyroxene, and troilite) are known within narrow limits. Thus, the abundance of oxidized iron in weathered chondrites can be related to specific starting compositions and to the level of terrestrial weathering [3, 4].

The RT spectra exhibit a complex mixture of magnetic, paramagnetic and superparamagnetic phases for all samples. They can be fitted with two Fe^{2+} doublets associated with the presence of olivine and pyroxene, and a third doublet attributed to paramagnetic and/or superparamagnetic Fe^{3+} oxyhydroxides (small-particle goethite, akaganeite, and lepidocrocite) identified only through low temperature measurements. A magnetic sextet, with a broad distribution of hyperfine fields, due to large-particle goethite is also included in the fitting together with magnetic components associated with Fe-Ni metal, troilite, hematite, and magnetite.

The spectra collected at 4.2 K allow the identification and quantification of almost all the phases present in the sample. These spectra are composed of troilite, goethite, magnetite, hematite, Fe-Ni (kamacite and taenite) and an additional magnetic component (B_{hf}= 48-49T) identified as akaganeite, present at RT as Fe^{3+} doublet. The olivine and pyroxene components show magnetic relaxation effects in all low temperature spectra and are fitted using the spheric relaxation model of the Normos program.

The Mössbauer spectral areas of Fe^{3+} components indicates that the oxidation level of the studied Atacama OC range from ~ 15% to ~ 75%. 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.

References: [1] Valenzuela et al. 2006. Abstract # 5203, *69th Meteoritical Society Meeting*. [2] Valenzuela et al. 2007. *Hyperfine Interactions* (*in press*). [3] Bland et al. 2002. *Hyperfine Interactions* 142: 481-494. [4] Bland et al. 1996. *Geochimica et Cosmochimica Acta* 60: 2053-2059.