FE-57 MÖSSBAUER STUDY OF THE MURRILI ORDINARY CHONDRITE.

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Introduction: The Murrili meteorite fell in the Kati Thanda – Lake Eyre South region of South Australia (29.26089 ºS, 137.53765 ºE) on 27 Nov. 2015, after being imaged and located by the Desert Fireball Network. This meteorite fell as a single stone of mass 1.68 kg. Petrography and a description of the fall and recovery are detailed elsewhere [1,2]. Despite its terrestrial age of about one month, the cut surface shows signs of extensive weathering with quite pronounced rusty staining distributed heterogeneously throughout the stone. We have obtained ^{57}Fe Mössbauer spectra of powder samples taken from both the 'altered' and 'unaltered' regions in this meteorite.

Experimental: The Mössbauer spectra were obtained at room temperature using a standard transmission spectrometer with a ^{57}CoRh source. The spectrometer's drive system was calibrated using a 6μm α-Fe foil. The spectra were fitted using a non-linear, least-squares, full-hamiltonian method.

Results and Discussion: In the figure below we show the ^{57}Fe Mössbauer spectra of the 'unaltered' and 'altered' materials in Murrili. Both spectra are well fitted with five components. The paramagnetic doublets of olivine and pyroxene account for 70 to 76 % of the spectral area and troilite accounts for around 13.5 % of the area. The other two components are a paramagnetic doublet characteristic of Fe^{3+} and FeNi metal. The most prominent difference between the two spectra is the relative spectral area contribution of the paramagnetic Fe^{3+} component. The 'unaltered' sample has an Fe^{3+} area of slightly more than 3 % whereas the 'altered' sample has around 12% relative area. This dramatic increase in the relative amount of the paramagnetic Fe^{3+} component comes at the expense of the olivine, pyroxene and metal components; the relative amount of troilite remains constant. This increase in Fe^{3+} points to an aggressive weathering process [3], in this case likely related to 30 day storage in warm, brine-saturated mud at the Lake Eyre fall site.

Another indicator of aggressive weathering may be drawn from the relative area of the silicates (olivine and pyroxene) compared to the metal. The 'unaltered' spectrum has 76.1(6) % relative area for the silicates and 6.8(4) % FeNi metal, yielding a silicate to metal ratio of 11.2(8). For the 'altered' spectrum these numbers are 70.0(6) %, 4.6(4) % and 15.2(14), respectively. The olivine to pyroxene ratios are 1.59 and 1.57 for the 'altered' and 'unaltered' spectra, respectively, putting Murrili firmly in the H-classification according to the work of Verma et al. [4], in agreement with its reported H5 classification [1]. However, the classification work of Verma et al. also suggests that the olivine + pyroxene content of Murrili should be accompanied by a larger amount of FeNi metal (around 9 to 13 area%) than measured (4.6 & 6.8 area%) to place Murrili in the 'H' region. We suggest that these data point to an aggressive weathering of the FeNi metal and silicate phases, leading to a paramagnetic Fe^{3+} component which is possibly goethite or akaganéite [5,6]. We speculate that the unusual heterogeneity in weathering may be a result of variable porosity.

References: [1] Benedix G. K. *et al.* 2016 (*this conference*). [2] Bland P. A. *et al.* 2016 (*this conference*). [3] Bland P. A. *et al.* 1998. *Meteorit. Planet. Sci.* 33:127-129. [4] Verma H. C. *et al.* 2003. *Meteorit. Planet. Sci.* 38:963-967. [5] Bland P. A. *et al.* 2000. *Quat. Res.* 53:131-142. [6] Bland P. A. *et al.* 1997. *Am. Miner.* 82:1187-1197.