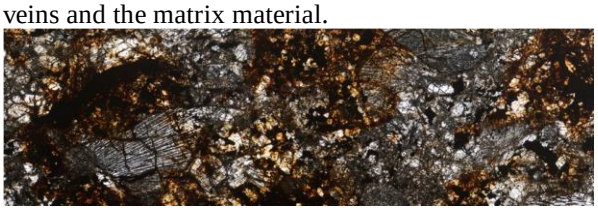
ANALYSIS OF THE NORTHWEST AFRICA (NWA) 12391 CHONDRITE METEORITE WITH EMPHASIS ON A SPINEL GRAIN AND ITS HOST CHONDRULE. D. Rezes[1,2], [1]Department of Petrology, Eötvös L. University, Budapest, H-1117, Pázmány sétány 1C, Hungary. [2]Research Centre for Astronomy and Earth Sciences, Hungary. Email: kisrezidani@gmail.com

Introduction: The recently classified NWA 12391 is a normal chondrite meteorite. Although there is a large number of such meteorites, L chondrites are worth for detailed research [1,2,3], as their analysis might clarify potential melting events [4,5] various weak alterations [6] or shock impact history [7,8,9,10,11] of the parent bodies [12,13]. Analysis of normal chondrites also could support the better targeting of asteroid missions [14,15].

Sample and Methods: The analyzed sample is a 51,4 gram piece of the NWA 12391 meteorite originally sized 5,5×3,5×2,5 cm, without fusion crust and a ~45 µm thick thin section was produced. The meteorite was analyzed by OPTIPHOT2-POL optical polarization microscope, INCA Energy 200 Oxford Instrument Energy-dispersive Spectrometer + JEOL Superprobe 733 electron microprobe. The infrared spectroscopic analysis was performed by Bruker Vertex FTIR plus 70 Hyperion 2000 microscope equipped with ATR objective, and for the micro XRD analysis a Rigaku D/max rapid instrument was used.

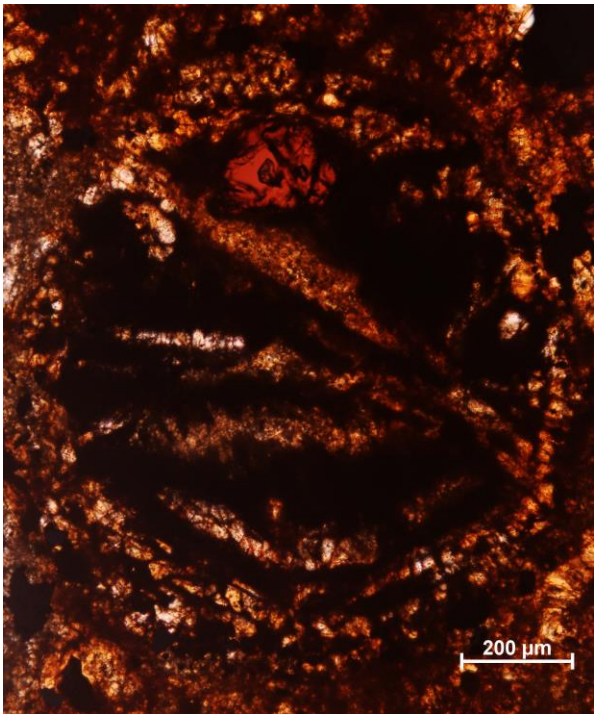
Results and Discussion: The sample shows one type of lithology, the edges of the chondrules are not sharp, the chondrule-matrix ratio is ~70%. Black melt veins were present in the meteorite (Figure 1). The diffuse chondrule edges indicating partial melting events and already started homogenization. The matrix is recrystallized, with many faults crossing the sample including melt veins form shock melting.

The average chondrule size is around 702 µm, with most of them are between 341 and 441 µm, while the maximal diameter is 2046 µm. The shock veins were opaque with 1 Nicol analysis, their width were below 200 µm, followed straight lines in most cases. Several cracks were filled with brownish desert dust, intruded after fall into the meteorite. The calcite composed veins host random located quartz grains, and there are opaque phases along the border between the veins and the matrix material.



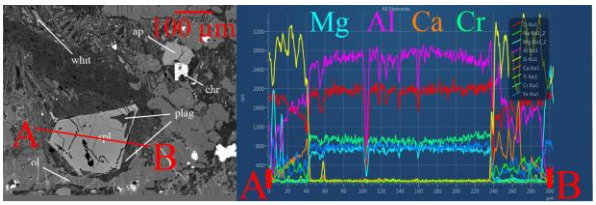
1. Figure **Typical chondritic texture of the NWA 12391, observing with 1N.**

The olivine grains showed 22.51±0,73 mol% Fa-content (N=18), while the low-Ca pyroxenes showed average 18.98±0.84 mol% Fs-content and 1.48±0.25 mol% Wo-content (N=10). Feldspars presented on the average 82.76±4.96 mol% (N=6) Ab-content, while their Cr-content were 0.003±0.004, and K-content 0.032±0.009.



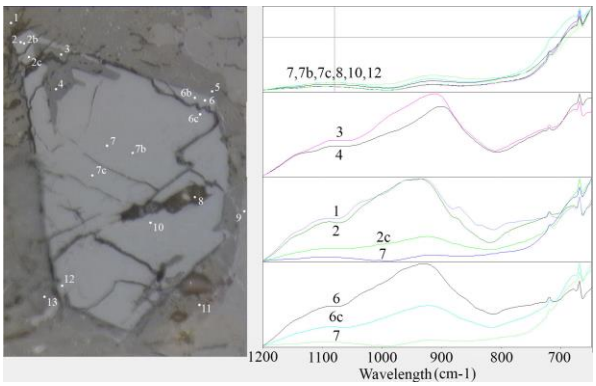
2. Figure **The large spinel grain with dark red color and its host chondrule, observed with 1N.**

A large, ~200 µm sized, euhedral, hexagonal, rectangular shaped spinel grain with dark red color and finely fractured surface was observed in one chondrule (Figure 2). The grain is surrounded by fine grained feldspar and one plagioclase grain is located inside the spinel. The host chondrule is surrounded by opaque rings. On BSE images the chondrule shows many fractures and veins. Beside the spinel, Cl-apatite, whitlockite, and around the chondrule edge chromite and FeNi could be present in small amount.



3. Figure **Microprobe profiles showing elemental compositional changes along the spinel grain.**

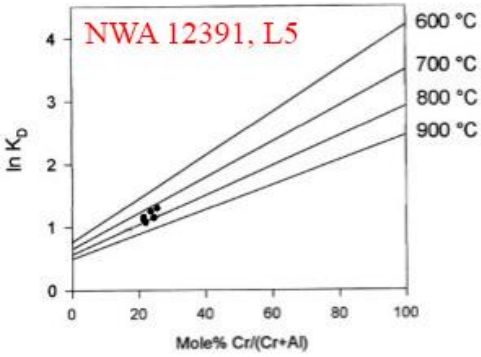
Analyzing elemental compositional changes along lines crossing the spinel (Figure 3), Mg- and Al-content showed decreasing abundance toward the edge, Cr-content did not show a strong trend. Along the border of the feldspar and spinel the Al- and Ca-content increase. The Ab-content of feldspar embedded inside the spinel was 45.98±14.62 mol%, while the Cr-content was 0.024±0.015 and K was below detection limit.



4. Figure. Example analyzed FTIR spectra of the spinel and surrounding phases.

The series of FTIR spectra (Figure 4) showed that from the feldspar toward the interior of the spinel the absorbance peak of feldspar was decreased, while the peak of spinel increased. The μXRD results showed the existence of andesine, spinel, olivine and magnetite minerals.

Thermal calculations: According to [16] olivine/Cr-spinel thermometer equation the Cr-spinel indicates 775±50°C temperature thermal metamorphism. Comparing the result to other author's spinel calculations, the measured Cr_2O_3 and FeO-content, correspond to the values determined by the Acfer 307 chondrite. But the MgO and Al_2O_3 values seem to be higher in the analyzed sample. The Fe# values is lower than those of the above mentioned Acfer 307 meteorite.



***5. Figure* Isotherm diagram for Cr-spinel for NWA 12391 chondrite.**

Conclusions: The results showed that the NWA 12391 is a moderately equilibrated meteorite with indication of thermal metamorphism. The processes equilibrated the Fe-Mg heterogenity between the olivine and pyroxene grains. The sharp borders between the chondrules and matrix became to blurred (5. petrographic type). The L type meteorite showed moderate signs of shock metamorphism (S3), and substantial weathering after fall (W3). The large spinel showed thermal interaction with the feldspar in contact, and the elemental ratios pointed to 775±50°C temperature metamorphism, what is in agreement with the results of other researchers on L5 chondrites.

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