Graphite-based geothermoetry of Yamato 74123 ureilitic meteorite

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In this work, investigation of diamond and graphite present in ureilite Yamato 74123 (Y-74123), performed by X-ray diffraction and micro-Raman spectroscopy, is reported. The formation and shock history of ureilite meteorites, a relatively abundant type of primitive achondrites, is debated since decades. For this purpose, the characterization of carbon phases can provide further information on diamond and graphite formation in ureilites, shedding light on the origin and history of this meteorite group. In this work, we present X-ray diffraction and micro-Raman spectroscopy analyses performed on diamond and graphite occurring in the ureilite Yamato 74123 (Y-74123). The results show that nano- and micro-diamonds coexist with nano-graphite aggregates. This, together with the shock-deformation features observed in olivine, such as mosaicism and planar fractures, suggest that diamond grains formed by a shock event (≥ 15 GPa) on the Ureilitic Parent Body. These results on Y-74123 are consistent with those obtained on the NWA 7983 ureilite and further support the hypothesis that the simultaneous formation of nano- and micro-diamonds with the assistance of a Fe-Ni melt catalysis may be related to the heterogeneous propagation and local scattering of the shock wave, as already reported for Almahata Sitta ureilite. Graphite geothermometry revealed an average recorded temperature (Tmax) of 1314°C (± 120°C) in agreement with previously estimated crystallization temperatures reported for graphite in Almahata Sitta ureilites.

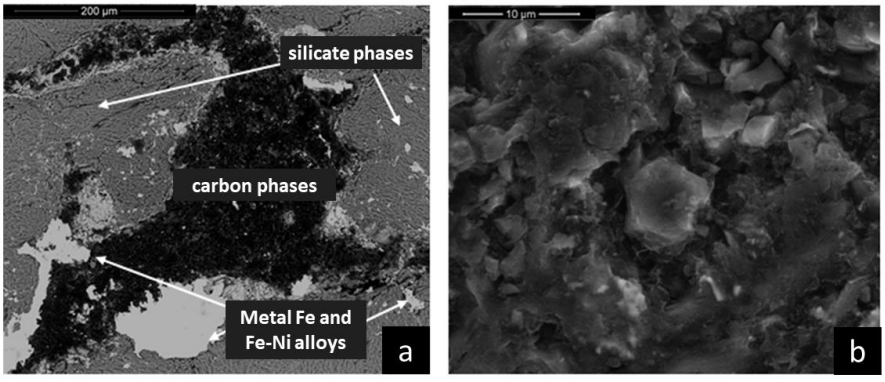

Figure 1. (a) shows the BSE image of a carbon aggregate from which the investigated carbon bearing sample was removed. Also note the presence of silicate phases and metal Fe and Fe-Ni alloys (metal + troilite + oxide); (b) detail of (a) in secondary electron (SE).