ESRF	**Experiment title:** CHARACTERIZATION OF PYROXENE MICRO-CRYSTALS FROM CHONDRITIC METEORITES	**Experiment number:** CH-230
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Report:

Chondrules are among the more primitive materials of the Solar System. They are uniquely found in undifferentiated meteorites and are a major source of information on the chemistry and condensation processes in the Solar Nebula. The classification of chondrules is based on their mineral phase association, texture, and composition. Among the most significant minerals we found silicatic olivine and pyroxenes. Specifically, low-Ca pyroxenes in chondritic meteorites can be orthorhombic or monoclinic (orthoenstatite or clinoenstatite), the polymorph and the structural state depending on the thermal history of the meteorite body.

Although it is well known in the literature that the detailed structure analysis of pyroxene minerals in Earth crustal and mantle rocks can yield important clues on the thermal history of the rock body, to date crystallographic studies on meteoritic pyroxenes are scarce, and mainly confined to differentiated meteorites, yielding no information on the formation history of primitive planetary bodies. The main reason for the scarcity of such studies is the difficulty of extracting suitable single crystals from the chondrules (Artioli and Davoli, 1994). In the present study we attempted the data collection of diffraction data from a number of small (<10-40 μm) pyroxene crystals from unequilibrated chondritic meteorites:

Gursum (H-4), Parambu (LL-4), Parnallee (LL-3), Soko-Banja (LL-4), Jolomba (LL-6). The aim is to obtain information on (1) the presence and relative amount of orthorhombic and monoclinic enstatite, related to the thermal processes experienced by the body, (2) the Fe-Mg intracrystalline site partitioning in orthopyroxene, related to the cooling speed from the high temperature protopyroxene stability field and to the closing temperature of Fe-Mg diffusion (Ganguly et al., 1989).

The first point has been addressed by collecting rotation patterns of untreated chondrules using penetrating radiation and a Siemens CCD Smart detector. The preliminary analysis of the image by full integration of the powder diffraction rings allows identification and semi-quantitative estimate of all phases present in the chondrule: the method showed to be a rapid and effective technique for the **non-destructive phase analysis** of the material. Since chondrules are relatively rare, this method can provide the only mean to investigate the mineral assemblage prior to destructive chemical and isotopic analyses (Viani and Artioli, 1997). Furthermore, detailed analysis of the Bragg reflections present in the diffraction image indicate the presence and the textural relationship of single-crystal grains within the chondrule, to be distinguished from the polycrystalline matrix. The textural information is an essential information for the correct interpretation of the chemical signature of the material.

As to the cooling history of the chondrules, the analysis of the Fe-Mg partitioning among the octahedral sites of the orthopyroxenes is being performed by full structural refinement of the single-crystal diffraction data collected on several microcrystals extracted from the chondrules. Out of the five collected datasets, two refinements were successfully completed and the results can be reliably used to extract the partitioning coefficient K_D related to the **Fe-Mg intracrystalline diffusion.** Since the K_D parameter is highly dependent on the quality of the measurements, the accuracy of the present results was tested by collecting diffraction data on one large crystal (-150 μm) both by conventional laboratory instrumentation, and by the synchrotron setup used for the opx measurements: the results on site occupancies agree within a few e.s.d.'s. The structural refinements on three of the datasets collected on opx microcrystals are unsatisfactory. The problems are likely to be caused by the presence of clinoenstatite lamellae at a microscopic level, which were undetected during the preliminary laboratory screening. Detailed analysis of the diffraction images of the opx crystals collected with the CCD detector is in progress in order to clarify the problem.

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Ganguly J, Bose K, Ghose S (1989) Fe-Mg ordering in opx and cooling rates of meteorites. *Lunar Planet. Sci. Con. XXZV, 5* 17-5 18.

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