

BARRED OLIVINE CHONDRULES MELTS GENERATED EXPERIMENTALLY AND THEIR THERMAL HISTORIES. P. Hernández-Reséndiz¹, K. Cervantes-de la Cruz², A. Segura¹, A. U'Ren¹, H. Cruz-Ramírez¹, B. S. Ángeles-García³, ¹Instituto de Ciencias Nucleares, Universidad Nacional Autónoma de México, Circuito Exterior, Ciudad Universitaria. A. Postal 04510 Ciudad de México, México, patria.hernandez@correo.nucleares.unam.mx, ²Facultad de Ciencias C.U., UNAM, karina-cervantes@ciencias.unam.mx, ³Instituto de Geología C.U., UNAM

Introduction: Chondrites preserve the oldest components of the Solar System. Chondrules are the main component of chondrites and they are among the most primitive materials in the Solar System: 4567-4565 Myr [1], their formation is contemporary to the planets accretion. They were formed at temperatures in the range of 1300 - 1800 °C in the course of several minutes [2,3]. The important unknowns in the formation of chondrules are: the precursors' starting composition, the physical conditions of their formation - like pressure, temperature and time -, and the mechanisms that produce them in the solar nebula. Two of the main aspects of chondrules are: 1. the retention of volatile materials which had not survived heating and/or cooling for long periods of time; 2. the existence of grains and edges indicating different heating pulses, instead of monotonic cooling after a single heating.

Barred chondrules. Barred chondrules represent the 10% of all chondrules in ordinary chondrites [4]. They determine an upper limit in temperature for chondrule formation conditions because their characteristic texture is only formed at highest temperatures (with respect to other textures).

It is not known what is the precise mechanism of heating of chondrule precursors. The most accepted model is originated by shockwave fronts propagating through the interior of the solar nebula [5]. The thermal histories provide the most important information in the chondrule formation, therefore the constraints on thermal histories are keys to find the processes that originated chondrules [6]. The formation models of chondrules propose thermal histories of chondrules which do not agree sufficiently well with those found experimentally.

Objectives: There are two main objectives:

- To determine what kind of heating conditions reproduce the features observed in chondrules located in chondrites.
- To associate the experimental thermal histories with those proposed by chondrule formation models, in order to constrain the conditions of the disk that gave rise to the Solar System.

Methodology: We simulate the formation of barred olivine chondrules by melting olivine crystals using a IR 50 W CO₂ laser emitting at a wavelength of

10.6 µm. We measure the temperature with a pyrometer during and after the melting, therefore each melt has one thermal history recorded. We perform petrological, chemical, crystallographic and textural analysis of the melts. These analysis will be compared with the natural chondrules. The thermal histories of those experimental melts that reproduce the characteristics of natural chondrules will be used to constrain the scenarios of chondrule formation.

Preliminary results: During the experimental chondrule formation, the maximum temperature range was 800 to 1800 °C. The crystallization time was of the order of 10⁻² seconds. The crystal bars width range is 9-16 µm; compared with natural chondrules, the bars width is similar to those in barred chondrules of some ordinary chondrites [7]. The diameter of experimental melts is similar to the natural chondrules [8], the range obtained was 500-1000 µm.

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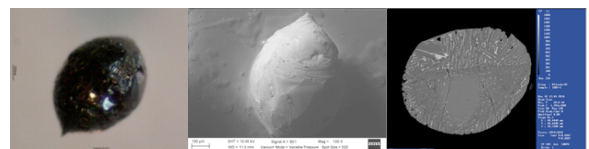


Figure 1. Sample EX16_5-2, one of the melts obtained seen with three different techniques: stereoscopic microscope, electronic microscope and electron probe micro analysis.