

### SILICA MINERALS IN NORTHWEST AFRICA 1878 MESOSIDERITE.

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**Introduction:** Silica polymorphs are useful to estimate a thermal history down to low-temperature [1, 2]. However, the relation between silica polymorphs and the quantitative cooling rate have not estimated yet because parts of silica's reaction rates at low-temperatures are too slow to demonstrate by experiments. In this study, we focused on mesosiderite. Since mesosiderites contain both pyroxene and Fe-Ni metal, the thermal history of mesosiderite from high to low temperatures can be quantitatively estimated. Mesosiderites also contain silica minerals, and therefore, the study of mesosiderites allows us to determine the relationship between the occurrences of silica phases and quantitative cooling rate from high to low temperatures.

**Methods:** We selected a mesosiderite with minimum thermal metamorphism to investigate silica minerals in a primitive mesosiderite. While thermal metamorphic degree of mesosiderites is traditionally classified into type 1-4, Northwest Africa (NWA) 1878 was reported as type 0, representing the lowest thermal metamorphic degree [3]. We prepared a thick section of NWA 1878, and performed petrological and mineralogical observations using an FE-SEM (JEOL JSM-7100F) at the National Institute of Polar Research (NIPR). EBSD and micro-Raman analyses (JASCO NRS-1000 at NIPR) were conducted to identify mineral phases.

**Results:** As reported in [3], cristobalite and quartz are identified in NWA 1878 as silica minerals. Cristobalite and quartz are present together, constituting aggregates (Fig. 1). The aggregates contained “fish-scale” fracture, which generally occurs during the transformation from  $\beta$ - to  $\alpha$ - cristobalite (from a high-temperature phase to a low-temperature phase) [4]. The fractures seem to be later filled by Fe sulfides/oxides. Cristobalite contains tiny inclusions, while quartz does not. The combination of silica minerals with the above mineralogical textures has also been observed in basaltic clasts in non-cumulate eucrites with low metamorphic degrees [2]. Moreover, heating and cooling experiments (from 1250 to 900 °C) using a eucrite powder have yielded similar occurrences of cristobalite and quartz at a cooling rate of 0.1 °C/hr [2].

**Discussion and conclusions:** Since cristobalite crystallized from eucritic melts transforms to tridymite during slow cooling at high temperature [2], the absence of tridymite in NWA 1878 indicates relatively rapid cooling after a crystallization. On the basis of the width of pyroxene lamellae, the previous study estimated that the cooling rate of NWA 1878 at high temperatures ( $>850$  °C) is similar to that of Pasmonte (non-cumulate eucrite), whose cooling rate is 0.01 °C/day above 850 °C [3, 5]. Thus, above discussion suggests that cristobalite cannot transform to tridymite at a cooling rate faster than 0.01 °C/day. For comparison, Erg Chech 002 (EC 002), whose cooling rate is 1-5 °C/yr (0.003-0.014 °C/day) [6-8] and slower than NWA 1878, contains cristobalite and tridymite. Tridymite in EC 002 is considered to have formed by transformation from cristobalite, indicating that the transformation from cristobalite to tridymite probably occurs at a cooling rate  $<0.003$ -0.01 °C/day. In other words, the presence of cristobalite without tridymite indicates that the cooling rate at high temperature ( $>850$  °C) is faster than 0.003-0.01 °C/day.

Our previous experiments have revealed that the cristobalite-quartz assemblages similar to those in NWA 1878 occur during simple cooling with a cooling rate  $<0.1$ -1 °C/hr (2.4-24 °C/day) at high temperatures ( $>900$  °C). Therefore, we consider that quartz in NWA 1878 should not form during thermal metamorphism but simple cooling because the cooling rate of NWA 1878 (0.01 °C/day) is slow enough to transform cristobalite to quartz.

**Future work:** The metallographic cooling rate of NWA 1878 will be obtained. We will analyze other mesosiderites showing strong thermal metamorphism in the same method employed in this study. Then, we can update a quantitative method to estimate thermal history using silica minerals

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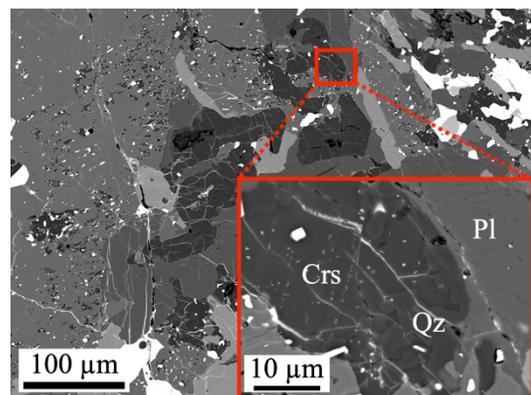


Fig. 1. A silica aggregate in NWA 1878