

LOW-CALCIUM PIGEONITE IN NORTHWEST AFRICA AND ASUKA UREILITES WITH REFERENCE TO PLANETARY PROCESSES.

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Introduction: The pyroxene polymorphic pairs found in the Antarctic ureilites have been helping us to deduce their annealing temperatures and cooling histories [e.g., 1-3]. Coexisting orthopyroxene (Opx) and pigeonite (Pig) assemblages occur only in the magnesian group [3]. Low-Ca clinopyroxenes with a chemical composition of Opx were also found in ferroan diogenites [4]. We report mineralogy of two ureilites with such low-Ca Pig in the Northwest Africa [5] and Asuka collections, and discuss their formation conditions in terms of pyroxene mineralogy.

Samples and Experimental Methods: One PTS of Asuka ureilite (A-881989) was obtained from NIPR and that of Northwest Africa (NWA) 4928 from National Sci. Museum in Tokyo (originally from Hori Mineralogy in Tokyo) [5]. Our methods include an optical microscope and EPMA at Ocean Res. Inst. (ORI) of Univ. of Tokyo and NIPR. Elemental distribution maps were produced to obtain modal abundances of minerals.

Results: Textures and chemical compositions and the crystallographic information of pyroxenes are given for each ureilite.

NWA 4928. One PTS of NWA 4928 consists of large to medium grains of olivine (up to 1.8x1.5 mm in size, core Fo₈₀₋₈₂) and pyroxene (1.1x1.6 mm to 0.7x0.4 mm), with a ureilite-like texture with dark veins, and many smaller grains (less than ca. 0.3 mm) in some parts of the PTS disturb the crystalline texture. Modal abundances of minerals are: olivine 58 vol.%, low-Ca pyroxenes 20%, metal and others 23%. Some pyroxene grains show a twin texture. X-ray diffraction study of a pyroxene crystal indicates the Pig structure (Y. Nakamura, KyU) [5]. Ca mol. % of pyroxenes (Fs₁₇Wo₅; Cr₂O₃ = 1.2 wt%) range from 5.2 to 5.6.

Asuka 881989. The PTS shows an aggregate mainly (ca. 70%) composed of elongated olivine grains (in longest dimension ~2 mm). Dark material occurs interstitially. Olivine composition is Fo_{86.8-77.8} with a cluster around Fo₇₉₋₈₀. Pyroxene composition is Fs_{17.6-19.4}Wo_{6.0-6.1}, and is low in Ca. A grain with lamellae texture shows some variations of Ca (Fs_{13.7}Wo_{5.2} – Fs₁₃Wo₁₄).

Discussion: If it were low-Ca pigeonite, its crystallization temperature is very high [3]. Formation at high temperature facilitate escape of partial melt by disequilibrium partial melting, and is in line with larger amounts of olivine in these ureilites [6]. Such low-Ca pyroxenes were found in the ureilite from asteroid 2008 TC₃ [7] and Dingo Pup Donga.

References:

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