Comparison of aqueous alteration of two CV3 (Kaba and Yamato-86751) chondrites. I. Gyollai [1,2] (gyildi@gmail.com), Sz. Nagy[1], Sz. Bérczi[1] , A. Gucsik[3] [1]Eötvös University, Faculty of Science, Institute of Physics, Dept. Material Physics, H-1117 Budapest, Pázmány P. s. 1/a, Hungary, [2]Department of Lithospheric Research Center for Earth Sciences, University of Vienna, Althanstrasse 14, A-1090 Vienna, Austria, [3]Konkoly Observatory of the Hungarian Academy of Sciences, H-1121 Budapest, Konkoly Thege Miklós út 15-17., Hungary

Introduction

The Y-86751 meteorite has been classified which is a transition of CVoxA and CVoxB groups, and it contains CAI's, dark inclusions, and amoeboid olivine assemblages [1]. However, the Kaba sample has been studied earlier [2,3], we performed a classification of some textural characteristics of the aqueous alteration of chondrules in our samples. This classification comprise five aqueous alteration stages [4]. 1) On their margin, the chondrules show fine-grained rim; 2) The crystallized rims of the chondrules were completely alterated into phyllosilicates; 3) Around the chondrule-forming minerals a fine-grained rim was discernible; 4) The chondrule's rim disappeared, but the chondrule-forming minerals show an alteration rim; 5) The whole chondrules were alterated to fine-grained phyllosilicates. These phenomena were observed not only in the case of the chondrules, but also in the phenocrysts of the carbonaceous groundmass.

Experimental procedure

The mineral assemblages and textures were characterized with a Nikon Eclipse LV100POL optical microscope using transmitted (plane- and cross- polarized) and reflected light (at Eötvös Loránd University of Budapest, Hungary).

Kaba meteorite

The Kaba meteorite contains altered chondrules with different extent, which are embedded in a carbon enrichment matrix and they contain altered chondrule fragments at different stages. Each chondrule can be divided into various altered shales, and their size depends on the timescale of the interaction with the aqueous fluid. These shales (or fragments) inside the chondrules were classified into 7 classes (Fig.1). 1) Well preserved crystal-fragments or chondrule cores; 2) Weak alteration: well-preserved crystals with amoeboid rim; 3) Phenocrysts are embedded in the phyllosilicate, which are containing matrix; 4) Phyllosilicate alteration exists inside the phenocrysts in the chondrule fragments; 5) Phyllosilicate alteration in the chondrule fragments and in the matrix, but the phenocrysts are well preserved; 6) Moderate alteration with amoeboid phenocrysts and well-developed phyllosilicate alteration; 7) Strong phyllosilicate development via aqueous interaction of minerals with wrong preserved phenocrysts, and Fe-Ni minerals (troilite and elemental nickel). They were observed at the rim of the chondrules and in strongly altered parts of them by using reflectance microscope. Most of the inner part is best preserved, and the rate of the alteration is growing to the direction of outer shales of the chondrules. Most of chondrules in Kaba meteorite have between 3 and 5 alteration stages on the basis of our classification.

Yamato-86751 meteorite

In the carbonaceous matrix, there are fine-grained chondrules with the grain-boundaries being smooth inside of the chondrules, as well. Three processes were considered in our interpretation: thermal metamorphism, brecciation, and aqueous alteration. The sizes of the chondrule-forming phenocrysts are approximately between 40-50 μm, whereas the phenocrysts in the matrix are up to 100 μm in size. This sample contains predominantly porphyritic chondrules. The minerals are zoned, possibly due to non- equilibrium reactions. Both the chondrules and larger phenocrysts show signs of aqueous alteration. The reddish-brown carbonaceous matrices are probably the result of the presence of altered hematite, which shows a flow-textured appearance. The groundmass has porphyritic texture, the phenocrysts are clino- and orthopyroxenes, olivines, and feldspar. The chondrules have porphyritic, barred, and granular texture. Some chondules are elliptical in shape. The xenoliths with porphyritic and granular texture are dark brown and black in color, probably due to carbon content. The granular and porphyritic chondrules commonly contain mechanically-twinned pyroxenes. The boundaries of the chondrules are smooth and often penetrated. The groundmass around the chondrules change from light reddish brown to dark brown showing flow texture due to aqueous alteration. Patchy extinction and fine grained textures are common in the chondrule minerals. The minerals are of inhomogenous composition, as it is indicated by the interference color differences of the feldspar and pyroxene grains. It is interesting to note that a spinifex-textured chondrule contained isotropic feldspar, i.e., maskelynite. This suggests that the meteorite is of S5-S6 shock stage, according to the Stöffler's scale [5]. Effects of the interactions of fluids are present in the form of fluid inclusion assemblages within fractures in feldspar grains, as secondary fluid inclusions, after Roedder [6]. Fluid inclusions are present also along boundaries of chondrules. Porphyritic chondrules show not only aqueously altered boundaries, but also that phenocrysts inside the chondrule show fine-grained rims around the mineral grains. If the aqueous alteration had been pervasive, the chondrules are completely altered to fine-grained minerals.

Comparison of Y-86751 and Kaba meteorites

Whereas the Kaba meteorite has more pervasive aqueous alteration inside their chondrules, the Y-86751 CV3 chondrite has more altered matrix with flow structure, but much better preserved chondrules. In Kaba sample, no shock features have been observed, but in Y-86751 sample mechanical twinned pyroxenes, moreover, maskelynite were found. The chondrules in Kaba sample consist of between 30-50 µm size crystalls. On the other hand, the chondrules in Y-86751 have coarser grains (between 80-100 µm). No fluid inclusions were observed in Kaba meteorite sample, but in Y-86751 meteorite fluid inclusions were present.

References

[1] Komatsu et al. (2007): *LPSC XXXVIII*, 1987.pdf; [2] Nakamura et al. (2007): Workshop on parent-body and nebular modification of chondritic materials; [3] Lukács and Bérczi (1999) *LPSC XXX.* 1011.pdf; [4] Kubovics et al (1998) *LPSC XXIX.* 1120.pdf; [5] Stöffler et al. (1991) *Geochimica et Cosmochimica Acta* 55/12, pp. 3845-3867. [6] Roedder E. (1984): Fluid Inclusions. Mineralogical Society of America, *Reviews in Mineralogy*,

Acknowledgments

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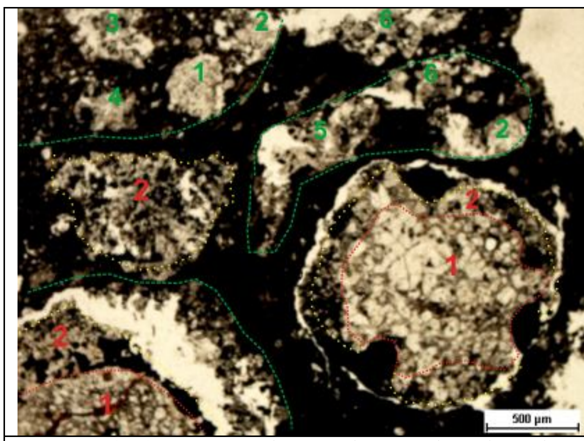
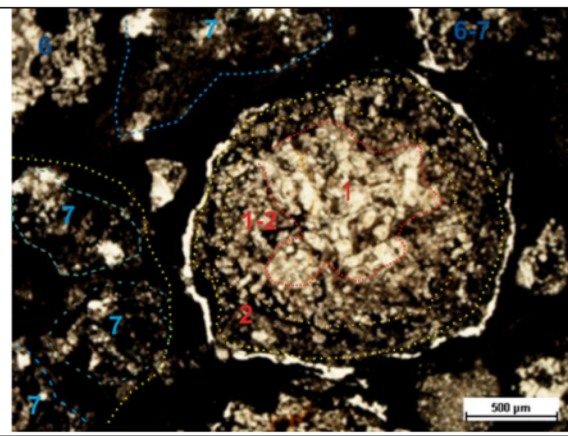
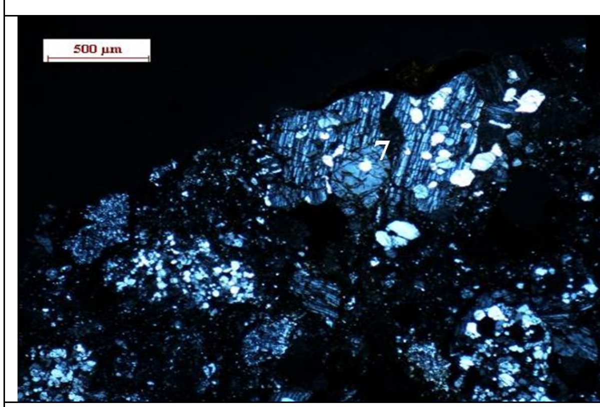
Figure 1. Optical microscope photos of Kaba (CV3 chondrite) sample in transmitted light (TL, A-B images), and reflected light (RL, D-image). The chondrules and chondrule fragments have differently altered sections which were marked with the following numbers: The alteration classes are explained in the text details. The alteration stages in chondrules are marked with red (1-4), and the mineral fragments indicate with green (1-3 stages) inside the chondrules. We marked the chondrule fragments with blue (1-7 stages). The C-image shows unambiguous shock metamorphism in a poikilitic chondrule from Y-86751 meteorite.



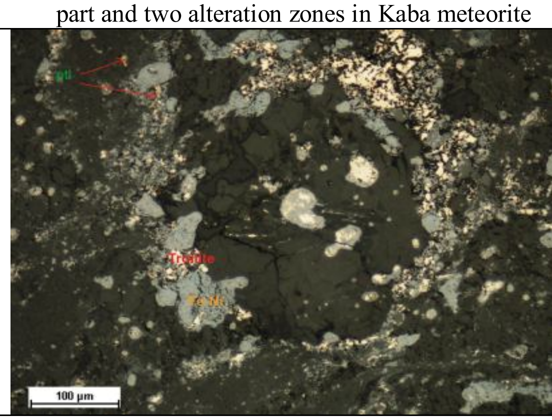
A: (TL) Accompaniment of water alteration of porphyritic chondrules in Kaba meteorite



B: (TL) Porphyritic chondrules with strongly altered clasts. Porphyritic chondrule with well-preserved inner part and two alteration zones in Kaba meteorite



C: (TL) Poikilitic chondrule: tabular shape and rounded olivines in mechanical twinned pyroxenes in Y-86751



D: (RL) Porphyritic chondrule with Fe-Ni rim and alteration zone in Kaba meteorite