A mineralogical and microstructural study of 7 eucrites (A-881394, Y-791195, Y-981617, Y-790266, Y-791186, Y-792510, Y-793591). H. C. Foucart[1], M. B. Holness[2], O. Namur[2], J. Vander Auwera[1], [1]University of Liège, Department of Geology, Liège 4000, Belgium, [2]University of Cambridge, Department of earth Sciences, Cambridge CB2 3EQ, UK.

The mineral chemistry and the detailed microstructure of seven eucrites (A-881394 [e.g. 1-2], Y-791195 [e.g. 3], Y-981617, Y-790266 [e.g. 4], Y-791186 [e.g. 4-5], Y-792510 [e.g. 4-5] and Y-793591) of the NIPR collection of Antarctic meteorites have been examined in order to constrain their modal mineralogy and chemistry and to explore the potential of microstructural analysis as a new tool for interpreting meteorites.

The minerals major element composition was analyzed with a Cameca SX 100 electron microprobe while a universal stage [e.g. 6] allowed measuring true dihedral angles [e.g. 7-8-9] in thin-sections (Figure 1). ImageJ, Gimp and GEOrient softwares were also used to produce elemental maps, to calculate modal mineralogy, aspect-ratios [e.g. 10] and fabric strengths [e.g. 11].

Our results are in agreement with previous work [e.g. 1-2-3-4-5]. Three meteorites, Y-792510, Y-791186 and Y-793591, are brecciated basaltic eucrites with a subophitic texture characterised by plagioclase and/or cloudy pyroxene grains set in dark comminuted matrixes. Y-981617 is a typical cumulate eucrite but the classification of the remaining three is less obvious. A-881394 and Y-791195 are granulitic whereas Y-790266 features a coarse-grained texture with abundant irregular and sub-rounded interstitial areas. There is some variability in the modal mineralogy of these samples. The proportion of pyroxene and plagioclase ranges from 41.4 (A-881394) to 60.7 (Y-791186) and from 33.6 (Y-791186) to 50.1 (A-881394) respectively.

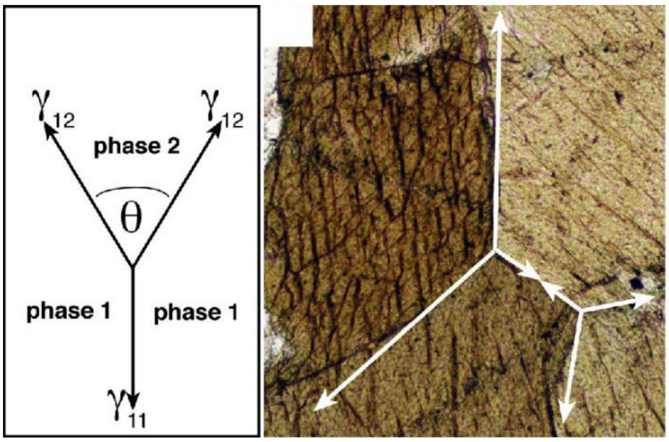

Figure 1. Left – the dihedral angle Θ formed at the three-grain junction by equilibration of the interfacial energies. Right – texturally equilibrated amphibole. White lines point out the tangents to the curved grain boundaries. The dihedral angle at this three-grain junction must be measured between the tangents [9].

The mineral chemistry demonstrates that all eucrites with the exception of Y-790266 are equilibrated (types 4-6) and highly metamorphosed with Y-791195 being the most metamorphosed sample. A qualitative assessment of the extent of equilibration of primary igneous textures was also made from a consideration of microstructure. Only the unbrecciated eucrites were used for this. Indeed, discrimination between different degrees of equilibration is possible by using the median of the population of pyroxene-plagioclase-plagioclase dihedral angles, with greater equilibration resulting in high dihedral angles [e.g. 7-8-9]. These medians can thus be used to place the unbrecciated samples in order of increasing metamorphism within a single coherent classification scheme. Analysis of lattice orientations of plagioclase grains in granulitic eucrites (A-881394 and Y-791195) suggests that these highly equilibrated meteorites were once cumulates, with a strong preferred orientation of elongate plagioclase. Subsequent thermal metamorphism led to the recrystallization and formation of a granular microstructure without the rotation of the original preferred lattice orientation of the plagioclase.

Based on the mineral chemistry and the texture of Y-791195 and Y-790266, we suggest including a third class of gabbroic eucrites in the usual two-fold classification of eucrites into cumulate and non-cumulate [e.g. 12-13]. This third type is characterised by an evolved composition similar to the basaltic eucrites but has an intrusive microstructure with medium to coarse grain size formed by slow cooling in a sub-surface environment.

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