THE PETROLOGY AND GEOCHEMISTRY OF CY CHONDRITES: A STUDY OF YAMATO 82162 AND YAMATO 980115

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Introduction: Three unusual carbonaceous chondrites – Yamato 82162, Yamato 86720, and Belgica 7904 - were studied by a consortium in 1992 [1]. Along with several meteorites found since then (e.g. Yamato 86789, Yamato 86029, Yamato 980115, Dhofar 1988 and Dhofar 2066), these aqueously altered and dehydrated meteorites have bulk oxygen isotope compositions heavier than any other carbonaceous chondrite group (typical $\delta^{18}O$ ~22 ‰ [2]) and an unusual mineralogy [3]. Although they experienced later thermal metamorphism, this cannot explain their distinct compositions [4]. Thus, while they are often linked to the CI or CM chondrites, it has been suggested they represent a new group of meteorites, the CYs [1, 4]. These meteorites are of particular interest as their extremely dark colour may suggest a relationship to the Hayabusa2 target Ryugu [5]. Here, we have studied the mineralogy, geochemistry and petrology of two of these meteorites, Yamato 980115 (Y-980115) and Yamato 82162 (Y-82162).

Methods: Thin sections of Y-82162 and Y-980115 were characterized using an FEI Quanta 650 FEG-SEM. The bulk composition of matrix phyllosilicates was determined using a Cameca SX100 electron microprobe, defocused to a beam size of 20 microns. More detailed element maps and focused spot analyses at a resolution of ~1 micron were made using a JEOL JXA-8530F Hyper-Probe EPMA.

Results: Y-82162 and Y-980115 are fine-grained brecciated meteorites containing abundant clasts of sulphides, magnetite, periclase and phosphate. Unlike the CI chondrites, they have relict chondrule-shaped features (typical size 10-50μm) consisting of phyllosilicates, magnetite, sulphides, carbonates and Mg-Ca-Fe bearing phases, consistent with a high degree of aqueous alteration. Figure 1 compares the matrix composition of Y-980115 with a CI1 and CM1 chondrite. The CI has a phyllosilicate composition that lies between serpentine and saponite, in keeping with TEM observations suggesting that the two are finely intermixed in CI matrix [6], whereas the CM1 has a composition closer to serpentine. In contrast, Y-980115 contains at least two distinct compositions; a Mg-rich serpentine and a component similar in composition to the CI.

Discussion: The two meteorites studied here, like most CYs, are petrological type 1, although B-7904 contains unaltered chondrules and is a CY2. The intial presence of chondrules in Y-82162 and Y-980115 is clear, but they have been fully altered. Other researchers have suggested the rare presence of altered CAIs in Y-980115 [7] and in B-7904 [8,9]. These meteorites are petrographically, geochemically and isotopically distinct from other groups and we support naming them "CY" chondrites.

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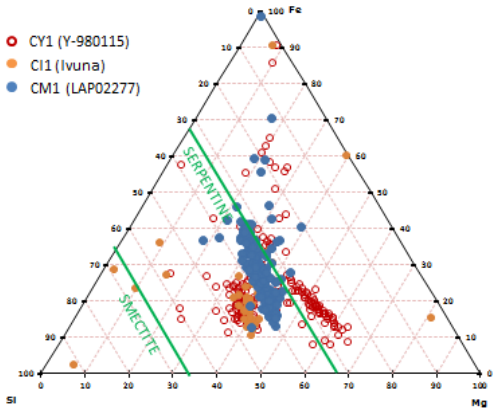

Figure 1. Matrix compositions of a CM1, CI1 and CY1 meteorite compared.