MODAL MINERALOGY OF MIGHEI, NOGOYA AND COLD BOKKEVELD CM CHONDRITES BY XRD.

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Introduction: CM chondrites have a variable texture that complicates mineralogical comparisons in thin section. They contain hydrous phyllosilicate formed by aqueous alteration. The CM parent body[ies] [1,2,3], or the solar nebula [4] are most often suggested as the site of alteration. Defining a rocks petrogenesis is difficult without modal mineralogy data, but optical or SEM point-counting studies of CM's are hampered by fine grainsize. We are therefore determining modal mineralogy of meteorites by XRD (technique described in [5] and [6]). Here we report data for Mighei(M), Nogoya (N), and Cold Bokkeveld (CB).

Results and Discussion: These meteorites have a diverse but related mineralogy controlled by the degree of aqueous alteration. For example, Mighei is composed of: olivine (15.6%); enstatite(6.6); calcite(1.1%); magnetite (3.6); cronstedtite (45%); Mg-rich serpentine (23%); and FeS (4.6%). We find that Fe-rich serpentine (cronstedtite) is a well-ordered crystalline phase. Remaining phyllosilicate is poorly crystalline and disordered (TEM indicates this is more Mg–rich serpentine [7]). The poorly crystalline structure suggests nucleation and re-nucleation during alteration, perhaps explaining the decrease in phyllosilicate grain size with increasing alteration [7].

We observe an inverse relationship in the abundance of cronstedtite and Mg-rich serpentine, reflecting the transition from Fe to more Mg-rich serpentines as aqueous alteration progresses [2,3,7]. There is also an inverse correlation between the modal abundance of Mg-rich serpentine and olivine+pyroxene that defines the degree of aqueous alteration. We define the alteration sequence as: (from least to most altered) M<N<CB - as in [2].

Interestingly, a positive correlation exists in the modal abundances of cronstedtite and anhydrous olivine+pyroxene. This may be interpreted to indicate a primordial or pre-accretionary origin for both phases and as evidence for aqueous alteration and phyllosilicate formation in the solar nebular [eg. 4]. This does not rule out further aqueous alteration on the parent body as both cronstedtite and anhydrous olivine+pyroxene are altered to more Mg-rich serpentine with progressive alteration. Indeed the correlation in modal phase variations between meteorites argues strongly for parent body formation of Mg-rich serpentine.

We are extending this study to explore the modal mineralogy of other carbonaceous chondrites so as to further reveal the site(s) of aqueous alteration.

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