The chondritic building blocks: Variations in time/space

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The different clans of chondrites preserve resolvable differences in chemical and isotopic composition; e.g., the chondrites can be assigned to clans defined by bulk chemistry and based on differences in isotopic compositions of Cr, Ti and Ni that were not produced by mass fractionation.

Kallemeyn and I showed that refractory lithophile abundances are high in carbonaceous chondrites, intermediate in ordinary chondrites and low in enstatite chondrites. As shown in Fig. 1, $\Delta^{17}O$ and $\varepsilon^{54}Cr$ show a negative trend with the highest $\Delta^{17}O$ in OC and the highest $\varepsilon^{54}Cr$ in CC. Thus both refractory abundance and isotopic compo-sition fully resolve the three clans.

Despite the fact that solar-system processes can produce non-mass dependent fractionation of O isotopes, there is no mechanical model explaining how to fractionation all the O in the terrestrial planets. Because stars produce very large frac-tionations in O it is highly likely that the meteoritic variations are of stellar origin. It seems clear that the ^{54}Cr fractionation is a nuclear effect produced in stars.

Thus the solar nebula was never mixed. If chondrite clans formed inside 3 AU, clans much have formed sequentially.

Planetesimals formed when nebular turbulence was low. If turbulence was mainly the result of high levels of action to the nebula, a simple scenario is that, during periods of high accretion, no planetesimals formed. When accretion was at a minimum planetesimals formed. Later enhanced accretion occurred again, and the process repeated. This episodic accretion model offers the simplest and best explanation of the compositional differences among chondrites.

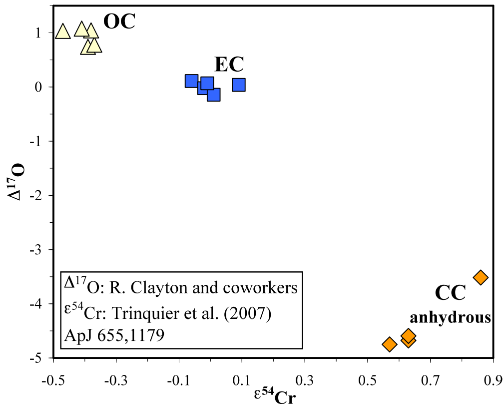

Fig.1.