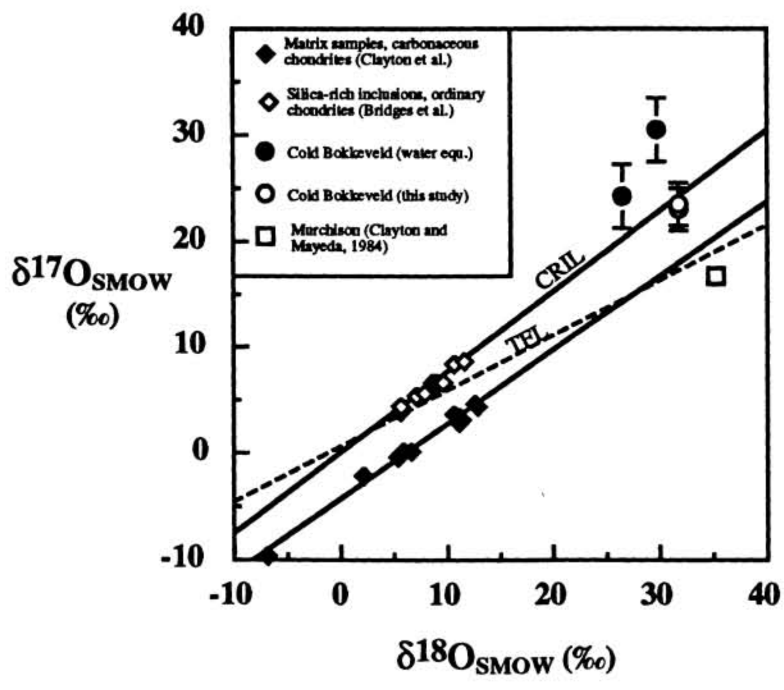
WHITHER CRIL? I.P. Wright[1], M.J. Wight[1], J.M. Gibson[1], M.M. Grady[1,2] and C.T.Pillinger[1]. [1]Planetary Sciences Unit, Open University, Walton Hall, Milton Keynes MK7 6AA, UK; [2]The Natural History Museum, Cromwell Road, London SW7 5BD, UK.

**Abstract**: Recently, Bridges et al. [1] have determined oxygen isotopic compositions of silica-rich clasts from Parnallee (LL3.6) and Farmington (L5). On an oxygen three-isotope plot these data fall on a line of slope 0.77, termed the "cristobalite line", or CRIL. Also falling on, or near to, the line are data for CRISPY, a silica-rich clast from the L6 chondrite ALH 76003 [2] and a silica-rich clast from Bovedy [3]. Clearly the line defined by these points is not without significance, but as yet it has not been fully explained. It appears that the degree of enrichment in the heavier isotopes of oxygen (gauged by the relative positions of individual data points along CRIL) is in some way correlated with the silica content of the individual clasts [1]. However, it should be noted that a nearly pure cristobalite clast from Farmington is not an end-member. In other words, the relationship of oxygen isotopic composition with mineralogy is not yet established. In order to solve this puzzle it would be desirable to constrain the nature of the material that must, at some point, have had an oxygen isotopic composition falling on an extension of CRIL, and which underwent isotopic exchange with the silica-rich clasts thereby producing the array of data which now defines CRIL.

It has been shown that up to 2% of chondrules in ordinary chondrites contain silica grains [4]. The formation of these silica-bearing chondrules, along with clasts of similar mineralogy, has been the subject of some debate, involving extreme viewpoints. As is the tradition in meteoritics, the battle-lines are marked at models involving either a nebular setting [5], or one taking place in a planetary environment [1,2,3]. In a bold departure from such posturing it has been proposed that both mechanisms might contribute, with silica-bearing chondrules being formed in the nebula and the clasts being planetary [4]. Herein we consider clasts only; relevant oxygen isotope data [1] are shown in the Figure. The trend defined by CRIL has been interpreted as the clasts having undergone isotopic exchange with an $^{16}O$-poor gas [1], an event considered to have taken place when the clasts were solid and resident in a near-surface planetary setting.

If the oxygen isotopic compositions of silica-rich clasts were indeed established during the operation of a planetary phenomenon, then it might be instructive to consider another form of late-stage alteration, i.e. that affecting the matrix materials of carbonaceous chondrites. Clearly this process is different to that which the silica-rich clasts of ordinary chondrites were subjected. The former involves a warm, wet surface undergoing hydrothermal activity, while the latter appears to require gas-solid interaction. And yet, when data for carbonaceous chondrite matrix materials [6,7] are added to the three-isotope diagram (see Figure) they define a line which is almost parallel to CRIL (slope 0.7, versus 0.77). Note that this is *not* the line normally plotted for carbonaceous chondrite matrix materials, which is drawn parallel to the terrestrial fractionation line (TFL), passing through a value obtained for carbonates from Murchison [7]. At this point it is necessary to re-open the case of the oxygen isotopic compositions ($\delta^{17}O$, $\delta^{18}O$) of meteoritic carbonates, as was first investigated by Swart et al. [8] using the $CO_2$-water equilibration technique [9]. At the time the results from this early study were considered inconclusive. Furthermore, the data are subject to an uncertainty which would be considered inordinately large compared to the levels of precision obtained from oxygen isotope analyses of silicates and oxides (obtaining the $\delta^{17}O$ of carbonates is a difficult process and has only been attempted once using the conventional fluorination procedure [7]). Nonetheless there is still merit in contemplating the results. Data for Murchison (not included on the Figure, for reasons of clarity) were found to plot as follows: 4 points clustering around the datum of Clayton and Mayeda [7], and 2 points significantly above the TFL. At very least this seems to suggest that the carbonates in carbonaceous chondrites could have a multi-stage history, which raises the validity of using any particular carbonate point to constrain the carbonaceous chondrite matrix line.

Data for Cold Bokkeveld [8], along with recent results obtained by a new solid-state equilibration technique [10] are shown on the Figure. It may, of course, be entirely coincidental that these data appear to plot on an extension of CRIL. However, there exists the possibility that the $^{16}O$-poor gas needed to produce the array of points that define CRIL, has also left its mark in carbonaceous chondrite carbonates. It is considered that in order to progress with this line of reasoning it would be advantageous to search for carbonates in Parnallee. This has been instigated and so the case continues...




Oxygen three-isotope plot showing data from silica-rich clasts from ordinary chondrites, carbonaceous chondrite matrix materials and carbonates from Murchison and Cold Bokkeveld.

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