A CONTINUUM OF AQUEOUS ALTERATION IN THE CARBONACEOUS CHONDRITES. P. A. Bland[1], G. Cressey[2] and O. N. Menzies[1], [1]Planetary and Space Sciences Research Institute, The Open University, Milton Keynes MK7 6AA, U.K., [2]Department of Mineralogy, Natural History Museum, Cromwell Road, London SW7 5BD, U.K.

Introduction: Most indices of aqueous alteration in chondrites are specific to a given chondrite type. A complete alteration index would include a measure of the overall abundance of those phases that are the products of aqueous alteration. Such an index would be applicable to all carbonaceous chondrites, allowing any correspondence between the measured degree of alteration, and other parameters (e.g. oxygen isotopic composition) to be assessed. However, estimating the abundance of a given phase using traditional point-counting in unequilibrated, heterogeneous, fine-grained CCs has proved to be a difficult task. We have therefore attempted to quantify the degree of alteration that a meteorite has experienced using a combination of ^{57}Fe Mössbauer spectroscopy (MS) and X-ray diffraction (XRD). MS detects only Fe-containing phases, but has previously been shown to provide a quantitative measure of terrestrial alteration in OC finds [1]: overall alteration is expressed as the percentage of total Fe present in Fe^{3+}-containing phases. XRD is effective in constraining modal mineralogy in CCs [2]. It provides a more complete measure of the abundance of all alteration products, quantifying those phases associated with parent body aqueous alteration (e.g. phyllosilicates, magnetite etc), as well as the abundance of fayalitic olivine, produced in either a nebular or parent body setting. Here we employ both techniques to explore the degree to which alteration is quantized in the CCs.

Results and Discussion: Mössbauer spectra were recorded from 9 bulk CC samples (16 were analysed previously [3]). XRD patterns for selected meteorites were recorded from the same material.

Our MS data indicates a huge range in Fe^{3+} contents in the CCs. Type 3 CC's vary from 2% (Warrenton) to 49% (Kaba), type 2's from 44% (Renazzo) to 80% (Essebi), and type 1's from 63% (Tagish Lake) to 95% (Orgueil). It is clear that there is significant overlap between petrologic types. As noted previously [3], the MS alteration index is positively correlated with oxygen isotopic and trace element volatile composition in the CCs.

Our XRD results confirm the MS data. We observe a large variation in abundance of fayalitic olivine, with significant overlap between different groups. Fayalitic olivine is also found in the CM1 meteorite ALH88045 (earlier petrographic studies had suggested that anhydrous silicates are absent in this sample [4]), and in Orgueil. In addition, there is a huge variation in the abundance of parent body aqueous alteration products in CCs. Again, we see overlap between petrologic types.

Conclusions: Our data are preliminary, but we find no evidence that aqueous alteration is quantized in the CCs – there appears to be a continuum of alteration, with substantial overlap between different petrologic types. In no sample has alteration gone to completion. Alteration and oxygen isotopic composition are strongly correlated, both between petrologic types, and within a given petrologic type. Our data tends to support a model in which CC parent bodies are zoned with respect to alteration and oxygen isotopic composition, similar to that proposed by Young et al. [5].

References: [1] Bland P. A. et al. (1998) *GCA, 62,* 3169–3184. [2] Bland P. A. and Cressey G. (2001) *LPS XXXII,* 1853. [3] Bland P. A. et al. (2000) *Meteorit. Planet. Sci., 35,* A28. [4] Zolensky M.E. (1997) *GCA, 61,* 5099-5115. [5] Young E. D., Ash R. D., England P. and Rumble III D. (1999) *Science, 286,* 1331-1335.