Textural properties of opaque phases in H-chondrites as a measure of thermal metamorphism

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The textural characteristics of iron-rich phases (metals and sulphides) have been quantified in the 8 H-chondrites that have been the object of previous extensive thermo-chronological study [1]. These samples are of interest as they have temperature-time paths during cooling that have been shown to be consistent with radiogenic heating by Al^{26} on a single parent-body [e.g. 2], thus offering the possibility to quantitatively link textural characteristics to thermal history.

The textural characteristics measured include: i) phase proportions, ii) the length of metal-sulphide contacts, iii) dihedral angle at contacts with silicate grains, iv) grain shape and circularity, v) grain size and size distributions. The absolute and relative proportions of metals and sulphides are approximately constant in all samples, consistent with evolution in a chemically closed system. With increasing degree of thermal metamorphism there is evidence for separation of metal and sulphide phases, increasing grain circularity, increasing grain size, and modification of size distributions. Variations of these parameters are found to be almost identical for sulphides and metals suggesting similar mechanisms for these two phases. Furthermore, between samples, trends are consistently in the same order: Sainte Marguerite (H4), Forest Vale (H4), Nadiabondi (H5), Richardton (H5), Allegan (H5), Kernouvé (H6), Guareña (H6), Estacado (H6). This order is exactly the same as that for depth within the parent-body derived from thermal modelling [2]. In detail, average grain-size is found to correlate linearly with inferred depth within the parent-body, opening the possibility to use grain-size as a quantitative measure of thermal metamorphism. Experimental data concerning grain-growth mechanisms [3], and some new measurements that constrain the activation energy of grain growth are used to show that observed values of grain-size are consistent with modelled thermal histories and available experimental constraints. Extension to a wider range of H-chondrite samples is planned.

[1] Trieloff M. *et al* (2003) *Nature*, **422**, 502–506. [2] Monnereau M. *et al* (2013) *Geochim. Cosmochim. Acta*, **119**, 302-219. [3] Guignard J., *et al* (2012) *Phys. Earth Planet. Int.* **204**, 37-51.