The secret life of impact breccias: chondritic phosphate shock textures

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Phosphate minerals in chondritic meteorites have been widely used to perform U-Pb geochronology [1, 2]. Complete diffusion of Pb from a phosphate crystal domain will reset the local U-Pb age e.g., during an impact event. Impact events will also disrupt the textural state of phosphate minerals. Indeed, crystal deformatiom/polymorphism may be responsible for controlling Pb diffusion at the sub-grain scale [3]. However, mineral textures are rarely considered in the study of phosphate U-Pb ages in shocked chondrites [1 vs. 2].

By a systematic classification of phosphate textures, we find evidence for shock-induced internal heterogeneity in many grains in shocked (S3-6) chondrites (Fig. 1). This should be taken into account during the interpretation of spatially-resolved U-Pb isotopic data. We argue that phosphate textures may act as an indicator of local PTt pathways, which, combined with compositional and U-Pb age data, should serve to resolve several long-standing debates in chondritic impact geochronology.

[1] Yin, Q. et al., 2014. MAPS, 49, 8. [3] Li & Hsu, 2018, American Mineralogist, 103. pp. 1789-1799. [3] Cernok, A. et al., 2019. LPSC abstract #2132.

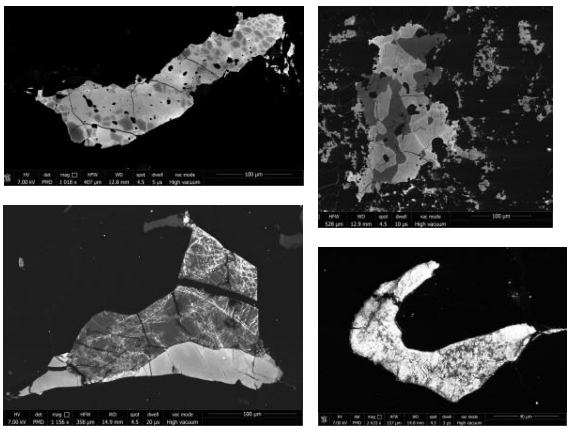

Figure 1: Cathodoluminescence images of shocked phosphate grains. (A) patchy merrrillite (Isoulane, S4), (B) patchy apatite (DaG 978, S3), (C) apatite-tuite polymorphism (Peace River, S6), (D) granularised apatite (Peace River, S6).