Atom Probe Tomography of Allende CAI Opaque Assemblage

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Calcium-aluminum inclusions (CAI) represent some of the earliest formed material in the Solar System [1]. The origin of metal and sulfide-rich opaque assemblages (OA) within CAI, and their associated refractory metal nuggets (RMN) is actively debated [2,3]. A persistent hurdle to studying the petrology of the phases with CAI and OA is that they are often sub-micron in size.

Laser-assisted atom probe tomography (APT) provides sub-nanometer spatial resolution with 10-100ppm detection limits, and has been used successfully on both terrestrial [4] and meteoritic refractory metals [5].

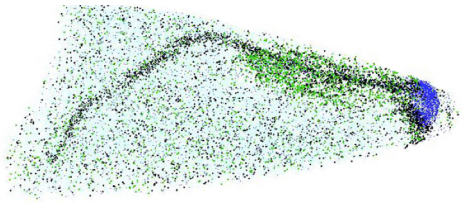

Figure 1. *Mg-rich grain boundary (black) in V-rich magnetite in Allende CAI OA. Ru-metal (blue) and sulphide (green) are located on grain boundary. Sample is ~200nm long. Dots are single atoms or molecules.*

We will present APT analysis of an OA in a type B CAI from the Allende meteorite. Phases analyzed include FeNi metal, V-rich magnetite, Ru-rich metal and Fe-sulfide. The spatial resolution of the atom probe allows sub-nm features such as grain boundaries (Figure 1) and heterogeneities within RMN to be imaged. We will discuss the implications of the atom probe analyses for the formation and metasomatism of Allende OA.

[1] MacPherson, G.J. (2003) Treatise Geochem. Vol 1:210-246. [2] Schwander D. et al (2015), Met. Planet Sci 50: 893-903. [3] Blum J.D. et al (1993), GCA 53: 543-556. [4] Parman S.W. et al (2015) Amer Min 100: 852-860. [5] Daly L. et al (2017) Geology 45: 847-850.