# Impact melt immiscibility and resulting element segregation on the Itokawa asteroid

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Impact melting is an important process for elemental redistribution and microstructural reworking of diverse bodies in the Solar System. Particles brought back from Itokawa provide an unique oportunity to study unaltred material in their original context (i.e. without glass hydration). Here we combine TOF-SIMS, EBSD, TEM, EDS and Atom Probe Tomography (APT) to examine one of the few impact melt rock particles recovered from the Itokawa asteroid by the Hayabusa mission [1]. This particle (RB-CV-0082) comprises a quenched emulsion of variable composition silicate glass, nanopores, and larger remnant crystals of high-Ca Cr-bearing pyroxene, olivine, and minor apatite, chromite and kamacite. TEM imaging, EBSD, and TOF-SIMS (≤50 nm spatial resolution) maps show two dominant glass compositions (Si-Al-Na-K and Fe-Mg-Ca-Ti) form interconnected amorphous globules. Locally, nebulous segregations of a Mg-Fe-Si glass are associated with partially- to totally-digested olivine grains. Within the Si-Al-rich regions, the alkalis (including K relavent to $^{40}Ar/^{39}Ar$ dating) were further segregated into even finer lamellae, alternating over 100 nm length scales. Further nanoscale analyses by APT are being undertaken to better understand trace element partitioning during impact melting. The texture of RB-CV-0082 is consistent with incipient melting during an impact event, with complete digestion of feldspar and partial digestion of olivine and pyroxene. The Si-rich and Fe-rich glass compositions are consistent with phase separation into conjugate immiscible liquids formed by spinodal decomposition in a multicomponent oxide system, preserved by rapid quenching [2]. Impact melt glass in Itokawa regolith requires that some portions of Itokawa are highly shocked up to S6. This study shows that this particle is a prime candidate to provide constraints on the age of the breakup of Itokawa's asteroid parent body [e.g., 3].

[1] Nakamura et al. (2014), Abstract at *Hayabusa 2014*. [2] Hamann et al. (in press), *Meteoritics & Planetary Science*, 1-39. [3] Jourdan et al. (2017), *Geology* **45**, 819-822.