

Composition Analysis of an Allende Chondrule using a Space-Prototype Laser Ablation Ionization Mass Spectrometer

Will soon fly to the Moon!



Fig. 1: Miniature mass analyzer of the spaceprototype LIMS instrument developed at UniBE. A UV femtosecond laser system is used to ablate sample material placed under the mass analyzer. Mass resolution: \sim 600; lateral spatial resolution: ~ 10 μ m [1].



Chondrule

Mesostasis

Inner rim

Outer rim

Matrix

Fig. 4: Unsupervised dimensionality reduction with UMAP and clustering with HDBSCAN separate the sampled area into distinct phases based on chemical composition [2]. Data of Fig. 2 were used as input.

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Fig. 3: Optical microscopy images of the Allende meteorite. Overview (A, XPL) and sampled chondrule (B: PPL, C: XPL). B and C were taken after LIMS analysis (laser craters visible, pixel size 50 µm).

Take-Home Message

 \rightarrow Chondrules in carbonaceous chondrites are amongst the oldest objects in our Solar System. Their formation is still not fully understood.

→ A space-prototype LIMS instrument was used to study a porphyritic olivine chondrule.

 \rightarrow The difference in composition between the outer rim and the matrix points to accretion from two distinct nebular reservoirs.

 \rightarrow Unsupervised ML techniques like dimensionality reduction and clustering can autonomously separate the data into distinct mineral phases.

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