
Introduction: Leoville was found in Kansas in 1961. It is classified as a reduced CV3. Within the reduced subgroup, it is one of the least metamorphosed members. Prominent features of this polymict fragmental breccia comprise type A and B Ca-Al-rich inclusions (CAIs) [e.g., 1, 2], dark lithic clasts [e.g., 1, 3], and amoeboid olivine aggregates (AOAs) [e.g., 4]. All constituents are set in a varied matrix [1]. In situ compaction led to structural deformation manifested in distinctive foliations [5].

Our study: In continuation of investigating refractory trace elements in meteorites [6], we will present comprehensive refractory lithophile element data on a representative series of objects from Leoville. In detail, we will
✓ give a petrographic overview of our sample, including
✓ a description of typical objects,
✓ quantification of the proportions of existing components, and
✓ examination of the bulk chemical composition of selected typical constituents.
We will also
✓ investigate the distribution of refractory lithophile trace elements in a selected range of objects.

First results: As first steps, we performed BSE and elemental mapping of an approx. 1 x 2.5 cm thick slab of Leoville. The mapping was carried out with a JOEL JXA 8900RL electron microprobe located at the Universität Göttingen, Germany.

The BSE map (Fig. 1) reveals a matrix-rich chondrite with significant terrestrial alteration. Weathering affected almost all iron phases in the meteorite. It also led to the precipitation of oxidized and hydrolyzed iron phases and limited terrestrial calcite in an extensive set of secondary veins.

Furthermore, the BSE map illustrates the variety of objects in terms of type and size. Our sample of Leoville is dominated by matrix and (deformed) chondrules and chondrule fragments.

In conjunction with a combined X-ray elemental map (Fig. 2; Mg = red, Ca = green, Al = blue), we can readily distinguish the major silicate minerals olivine and pyroxene. In addition, we can identify different CAIs, an AOA, and a single Ca-Al-rich mineral of appreciable size (approx. 700 x 300 µm).

Outlook: In addition to the microprobe work, we will apply laser ablation ICP-MS (LA-ICP-MS) techniques in order to determine the inventory of refractory lithophile trace elements. The ICP-MS analyses will be performed at the Australian National University in
Canberra. Details on method and apparatus have been published previously [7].

The refractory trace element data will help place constraints on the chemical conditions in the early Solar System in general and on the formational history of Leoville in particular. Previous studies [e.g., 6, 7] suggest that fractional condensation played an important role in the accretionary disk of the young Solar System. Knowledge of the refractory trace element inventory and its distribution in the Leoville CV3 meteorite will contribute to understanding the cosmochemical processes and condensation sequences at that time.

References:

Figure 2. Combined X-ray map of Leoville (Mg = red, Ca = green, Al = blue). Dimensions are 90 x 224 mm. Ca-Al-rich inclusions (CAIs) are readily distinguished from chondrules. The map also shows additional Al- and Ca-rich phases. The conspicuous Ca-rich vein filling is most likely terrestrial calcite.