The bulk chemical composition of carbonaceous chondrites determined by SF-ICP-MS

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Concentrations of many trace elements, and in particular those of volatile elements in carbonaceous chondrites are still poorly known. We developed a method for the analysis of major and trace elements in carbonaceous chondrites using HF-HNO_3 bomb digestion, chondrite-matched external calibration and internal standardization. Samples were 2,000 and 10,000 fold diluted for trace and major element analysis, respectively.

Our sample set includes several aliquots of Murchison (CM2) that have been heated to different temperatures in a stream of either O_2 or Ar, in order to study the loss of volatile elements at different oxygen fugacities. At 600 °C first element losses are observed, with Cd being volatilized under reducing conditions and S and Se under oxidizing conditions. The highly siderophile elements Re, Ir and Pt are extensively lost under oxidizing conditions at T>800 °C.

Furthermore, different carbonaceous chondrite groups were analyzed, with a special focus on the CM group. CM chondrites represent an overall homogeneous chemical composition, independent of the degree of weathering or aqueous alteration. Antarctic samples do not suffer strong terrestrial alteration in contrast to the hot desert sample Jbilet Winselwan [1]. The composition of Tagish Lake (C2) is identical to the CM chondrite group but the most volatile elements are less depleted [2]. With minor exceptions, volatile elements with 50 % T_{cond} <750 °K are depleted to the same extent relative to CI in each group. This pattern results from 2-component mixing of volatile element depleted refractory matter with a component of CI composition. Two samples deviate from this general pattern. The Antarctic CI chondrite Y-980115 is nearly completely depleted in Bi, In, Cd and Tl relative to Ivuna, while EET 96026, which displays a CV chondrite like overall element pattern, shows a more severe depletion of all volatile elements with condensation temperatures lower than Cs (except Zn and Se). This volatile element loss may result from thermal alteration on the parent body [e.g. 3].

[1] Friend *et al.* (2016) *LPSC* **47**, #1893. [2] Friedrich *et al.* (2002) *MAPS* **37**, 677-686. [3] King *et al.* (2015) *GCA* **165**, 148-160