Geophysical Research Abstracts
Vol. 14, EGU2012-10140, 2012
EGU General Assembly 2012

Methyl-methionine as a precursor for methyl chloride and dimethyl sulphide produced in terrestrial salt lakes

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Volatile organic halocarbons (VOX) play an important role in the photochemical processes of the lower atmosphere and information on the geogenic origin of these compounds will help to understand global VOX budgets and fluxes. However, investigations concerned with occurrence of VOX in fluid inclusions of rocks and minerals are scarce (Harnisch and Eisenhauer, 1998; Svensen et al., 2009).

The composition of volatile organic carbons (VOC) trapped in fluid inclusions of halite crystals deposited in recent salt pans was analysed using a purge and trap GC-MS technique. Besides an array of identified volatile compounds we noticed the occurrence of chloromethane (MeCl), dimethylsulfide (DMS) or both in most of a divers set of samples. Methyl chloride with an atmospheric burden of 4 to 5 Tg, is the most abundant halocarbon in the atmosphere. It plays a significant role in chlorine-catalyzed ozone destruction in the stratosphere (Keppler et al., 2005; Montzka and Frazer, 2003). DMS is the major natural, mainly marine, source of sulphur in the atmosphere and contributes to both the tropospheric burden of sulphur as well as cloud properties via oxidation to acidic aerosols (Kloster et al., 2006; Sievert et al., 2007). It is also known that a conversion of methionine (MET) to dimethylsulfonium-propionate by phytoplankton takes place, which in turn serves as the main precursor for DMS emission from the surface ocean to the atmosphere (Sievert et al., 2007).

In search of a possible precursor for the above mentioned two compounds we hypothesize that the compounds trapped in the fluid inclusions represent compounds originally formed in the immediately subjacent sediment. MET, as one of three sulfur containing amino acids, could potentially serve as a precursor for MeCl and DMS formed in salt lake environments. To test these hypotheses, we measured selected sediment samples that correspond to the previously measured salt samples.

Separately, we studied the temperature dependence of the MeCl formation from methyl-methionine (Me-MET) and, in addition, structurally related compounds to methionine in order to understand the formation mechanism of MeCl and DMS.

Our results showed that an emission of MeCl and DMS from salt pans via MET/Me-MET decomposition appears plausible.

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