

Time-Of-Flight Secondary Ion Mass Spectrometric Analysis of Residues from Fluid Inclusions in Terrestrial Glass and Their Possible Connection to Cometary Interplanetary Dust

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Introduction

The role of cometary material as a possible carrier of water in the early history of the terrestrial planets has been vividly discussed in the past [1,2]. To test this hypothesis directly, fluid inclusions in artificial glass were analyzed by time-of-flight secondary ion mass spectrometry (TOF-SIMS) [3]. The results are compared with data from primitive meteorites [4], interplanetary dust particles [5], and comets [6].

Samples

While the origin of the glass remains uncertain due to enormous recycling activity in the respective industrial region, the origin of the fluid phases can be localized to a carefully selected group of three regions in Germany (Münster, Dortmund, and Kreuztal). To examine the variability within one locality, four significantly different fluids from one of the regions (Münster) were selected. Samples from Münster are labeled Pinkus Spezial, Pinkus Alt, Pinkus Pils, and Pinkus Jubilate, the one from Dortmund is Wicküler Pilsener, and the one from Kreuztal is Krombacher Pils. Host glasses are bottle-shaped and have sizes of 500 cm³ with the exception of 330 cm³ for Pinkus Jubilate (Fig. 1).



Fig. 1: Samples analyzed in this study

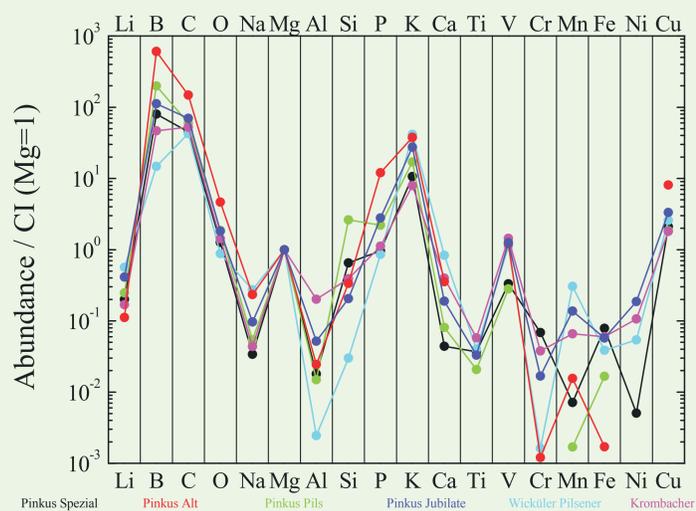


Fig. 2: Element abundances normalized to magnesium and CI chondrites

Experimental Procedures

Since TOF-SIMS analyses are performed under ultra-high vacuum, the fluids had to be evaporated and the residues were analyzed on Si-wafers as substrates. In all cases the residues had an appropriate thickness and no signal from the substrate material appeared in the respective mass spectra. Prior to the TOF-SIMS analyses, all samples underwent an intensive tasting procedure by the co-authors of this study. Although certainly not objective, only this part of the investigation guarantees that positively high-quality products from German breweries are distributed during the meeting.

Results

The first astonishing result already emerged during sample preparation. While most residues showed beginning crystallization in vacuum, one sample (Pinkus Spezial) remained amorphous. The mass spectra showed huge differences, both, between fluids from different localities as well as between different fluids from the same locality. Pinkus Spezial, Pinkus Jubilate, and Krombacher Pils showed within a factor of three CI-like element ratios for Na, Al, Ti, Mn, Fe, and Ni (Fig. 2). Wicküler Pilsener has no such similarity to CI but a chondritic Fe/Ni-ratio. Pinkus Alt and Pinkus Pils are both non-chondritic.

Discussion

High Mg/Fe-ratios (13–587 × CI) connect the studied fluids to primitive solar system material [4–6] supporting an earlier infrared study, which demonstrated the similarity of Aetnean wine samples to comets [7], although an extraterrestrial origin is still somewhat questionable in both cases. The epochal concept, however, that, in contrary to the dirty-snowball-model, comets mainly consist of beer [8] has not unequivocally been confirmed.

Selection of Major Conference Fluids

The complex selection process for the fluids followed four general principles: (1) At least one fluid with chondritic element ratios has to be selected. (2) Fluids from local inclusions should be preferred. (3) The selected fluids should come close to two end members in the multidimensional space of taste – they should be different. (4) All co-authors should agree on their good taste. With these principles in mind we selected the two fluids shown in Fig. 3.

Outlook

The intensive tasting procedure can be applied to further fluids during the poster session. We invite all participants to take part in this selfless investigation to ensure variability on a high-quality level also for future meetings.

References

- [1] Debonno A. H. (1992) In *Astrochemistry of Cosmic Phenomena* (ed. P. D. Singh), 421–422.
- [2] Laufer D. et al. (1999) *Icarus* 140, 336–450.
- [3] Stephan T. (2001) *Planet. Space Sci.* 49, 859–906.
- [4] Leitner J. et al. (2003) *Meteorit. Planet. Sci.* 38, A93.
- [5] Stephan T. et al. (2003) *LPS XXXIV*, #1343.
- [6] Jessberger E. K. (1999) *Space Sci. Rev.* 90, 91–97.
- [7] Strazzulla G., pers. comm.
- [8] Hoppe P., pers. comm.



Fig. 3: Fluids selected for conference: Pinkus Alt (left) and Pinkus Jubilate (right)