# NOBLE GAS INVENTORY OF TRANSANTARCTIC MOUNTAIN MICROMETEORITES: INSIGHTS INTO THEIR PROVENANCE.

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**Introduction: :** A variety of processes have been considered possibly contributing volatiles, including the noble gases, to the terrestrial planets (e.g., [1-3]). Special consideration has been given to the concept of accretion of volatile-rich materials by the forming planets. This might include infalling extraterrestrial material of various sizes, i.e. from planetesimals down to dust, and could include material from the outer asteroid belt, as well as material of cometary origin. Currently, the dominant source of extraterrestrial material accreted by the Earth is represented by micrometeorites (MMs) with sizes mostly in the 100-400 µm range [3, 4]), and according to [3] accretion of early micrometeorites may have played a major role in the formation of the terrestrial atmosphere and oceans. We have therefore set out to investigate in more detail the complete inventory of noble gases in MMs. Here we summarize some of the results we obtained on MMs collected in micrometeorite traps on the tops of the Transantarctic Mountains [5].

**Trapped noble gases:** Concentrations in "unmelted" MMs, in the size range ~400-1000 µm, are compared to those in CM meteorites (exemplified by CM2 Maribo) in Figure 1. While He has been largely lost, the abundance of Ne often exceeds that in CMs, because of higher abundances of trapped solar wind Ne. Ar, Kr, Xe are somewhat lower and quite variable. This is in line with our mineralogical observations on separate pieces of the analyzed MMs that mostly show similarities to ordinary chondrites of various types rather than CMs - contrary to the situation for recently fallen MMs recovered from ice and snow of Central Antarctica [6, 7]. Note, though, that uncertainty is induced by a) the fact that the MMs are often not homogeneous in composition and b) the complex interaction during passage through the terrestrial atmosphere. Among others, we found in several cases (two scoriaceous, one unmelted) Kr and Xe showing the signature of isotopically fractionated air with the heavier isotopes enriched [8].

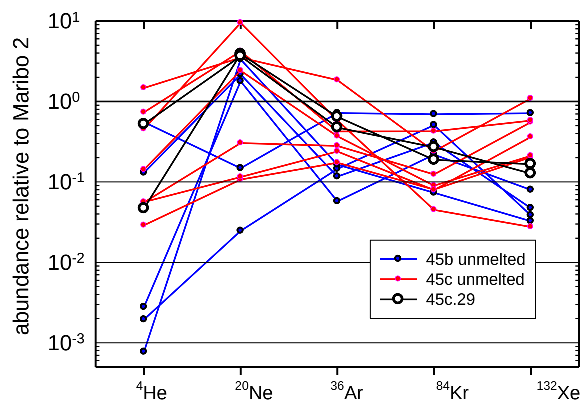


Fig. 1. Trapped noble gas abundances in nominally unmelted TAM MMs, normalized to CM Maribo [9]. Two fragments of the special MM 45c29 are shown. In addition, for an aliquout of one of the plotted MMs as well as for one additional "unmelted" MM abundances were below detection limit.

**Cosmic ray exposure:** Neon is generally dominated by fractionated solar wind, but cosmogenic contributions are apparent in a number of cases. Cosmogenic noble gases can be used to infer cosmic ray exposure and (due to the Poynting-Robertson effect) the distance from the sun where particles (or dusts) began their journey to the inner Solar System [10]. In addition the isotopic composition of cosmogenic Ne contains information about irradiation conditions. From a comparison with model predictions [10] it follows that data for the MMs with the clearest cosmogenic signature are incompatible with irradiation by galactic cosmic rays (GCR) as small particles. Precursors of MMs could have been exposed to GCR as part of a larger body or to solar cosmic rays (SCR) as small particles. In the latter case a SCR energy spectrum is required that is softer than the one favored in [10].

**45c29:** This MM is characterized by several unique features: a) high abundances not only of cosmogenic Ne but also cosmogenic Ar, with extremely low cosmogenic $^{21}$Ne/$^{38}$Ar in one analyzed aliquot, but less so in a second specimen, attesting to an inhomogeneous composition; b) evidence for radiogenic $^{129}$Xe and fission Xe from $^{244}$Pu. These properties are similar to, but not identical in all details, to achondrites or Ca-Al-rich inclusions (CAIs). Since for MMs derived from beyond ~ 4 a.u. the GCR contribution should exceed that from SCR [10], the high abundance of cosmogenic Ne is difficult to reconcile with its isotopic composition.

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