Geochemical characterization of tire-wear particles

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Tire-wear particles are a basic component of common road dust present in urban environments, and their annual emissions to the environment in Germany are reported to be 60 x 10^6 kg [1]. The knowledge of their basic characteristics can be useful to trace tire material in environmental dust samples and for the evaluation of possible health effects related to the inhalation of tire-wear particles. For this study, we analyzed particles generated in a closed indoor tire test rig at the Bundesanstalt für Straßentechnik (BAST) from three car tires as well as particles generated by cryogenic milling of shredded waste tires.

Particles ranging in size from 0.2 μm to 25 μm were characterized with a scanning electron microscope (SEM). All samples contained particles with diameters <0.6 μm. According to their morphological and chemical features the particles were divided into characteristic groups. The bulk chemical composition of each sample was distinct, with the total carbon content varying between 28.73 and 83.75 wt%. Inductively coupled plasma mass spectrometry (ICP-MS) data revealed significant variability in the contents of various trace elements (e.g. Pb 3.4 ppm - 437.2 ppm). Characteristic among all samples was a very high Zn content (> 1100 ppm). In addition, the ratios of ^{87}Sr/ ^{86}Sr, which varied from 0.7089 to 0.7094, and of ^{204}Pb/ ^{206}Pb, with values between 0.0560 and 0.0570, were found to be characteristic for the tire-wear particles, but differed from the ratios measured for the shredded tires. Comparison of the Pb isotope ratios with literature data [2, 3] from road-related dust samples (e.g. pavement particles or brake-wear) and traffic-related lead sources (e.g. batteries or gasoline) showed that Pb isotope ratios could be used as a tracer for the tire-wear contribution to road dust.

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Mojave Crater, Mars: One meteorite source crater

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The Mojave Crater on Mars has a diameter of about 55 km; it is situated at 7.5˚N and 33.0˚W at the joint of Simud and Tiu Valles in Xanthe Terra. It attracted attention for its well preserved landforms resembling the morphology of alluvial fans in arid environments, and suggesting a very young formation age. However, because of its large size, speculations on the age range from late Hesperian to late Amazonian age.

From crater count statistics technique, we here demonstrate that Mojave formed only 2-4 Ma ago. Such a young age makes it a prime candidate for being the ejection source of seveal groups of martian meteorites. Additional potential links (site mineralogy and presence of an extended ejecta ray pattern) between this crater and the SNCs will be discussed.

Because Mojave formed on old Noachian terrain, it questions the original crystallization age of shergottites. A 4.1 Gyrs old was inferred by debated Pb-Pb isotope ratios (*Bouvier et al. , 2008, EPSL 266, 105-124; Bouvier et al. , 2013, LPSC No. 1719*), whereas some apparently young crystallization ages (173-596 Ma, *Mars Meteorite Compendium, JSC Pub. No. 27672*, the latter is Tissint, which is the oldest, *Brennecka et al. , 2012, 75th Met Soc abstract No 5157*) are more commonly accepted. We will attempt to reconcile our observations with the debate about the age of shergottites.

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