REFRACTORY ELEMENT FRACTIONATION (OS/IR, RH/IR, RU/OS) IN IMPACT CRATERS: PROJECTILE IDENTIFICATION OF ROCHECHOUART, SÄÄKSJÄRVI, BOLTYSH, DELLEN, MIEN, ETC. G. Schmidt. Universität Mainz, E-mail: schmdtgerhard@aol.com.

Introduction: Meteorite crater studies [1-4] confirmed an extraterrestrial contamination in Rochechouart and Sääksjärvi impactites. Recently non-magmatic iron meteorites (IA and IIIC) have been suggested as projectiles for both craters [4], in contradiction to previous studies [1-3] favour magmatic irons.

Non-refractory elements and Cr isotopes: Ni/Cr, Co, and Au are less useful for projectile identification. The reasons are: (1) high target abundances (upper crust: 47 ± 11 µg/g Ni, 92 ± 17 µg/g Cr, 17 ± 1 µg/g Co, 1.5 ± 0.4 ng/g Au [5]; upper mantle: 1860 ± 93 µg/g Ni, 2520 ± 252 µg/g Cr, 102 ± 5 µg/g Co, 0.9 ± 0.1 ng/g Au [6]), (2) mobilisation by secondary processes, (3) no correlation of Ni and Cr versus highly refractory siderophile elements in impactites from many craters, (4) limited database for $^{\varepsilon 53}$Cr in irons and pallasites, and large variations of 0.9ε units of ^{54}Cr-rich and ^{54}Cr-poor acid leach fractions recently found in carbonaceous chondrite Orgueil [7], and (5) large variations of $^{\varepsilon 53}$Cr in different crater samples (e.g., Morokweng).

Refractory highly siderophile elements: Refractory highly siderophile elements, such as Os and Ir, are abundant in most meteorites but depleted in crustal rocks (low target/meteorite ratios) and therefore the most reliable elements for projectile identification. However, target/meteorite ratios are high if target rocks consist of mantle rocks. In this case elements are enriched in impactites due to the relatively high abundances (ng/g level) in target rocks to make the identification of projectile types impossible (e.g., Gardnos impact structure in Norway [8]). One of the most reliable key ratio that rules out Earth upper mantle derived refractory highly siderophile element components in impactites is Ru/Ir. The well established Earth mantle Ru/Ir ratio of 2.0 ± 0.1 is significantly above Ru/Ir (1.4 to 1.6) of different chondrite groups.

Magmatic iron projectiles (MIP): Refractory highly siderophile element abundances from Rochechouart and Sääksjärvi impact craters are not compatible with the projectile composition of non-magmatic iron meteorites suggested by [4]. Osmium/Ir, Ru/Os, and Rh/Os rules out IA and many other meteorite classes as projectile types for both impact sites. Osmium/Ir in impactites from both craters are more than 3 times lower than Os/Ir measured in the metal phase of non-magmatic iron meteorites. Subchondritic Os/Ir amongst other refractory siderophile element ratios are strong arguments to conclude that Rochechourt and Sääksjärvi impactors are IIA or IIIAB irons [1], [3]. Impact melt rocks from both craters and other known impact craters (Dellen, Mien, Boltysh, etc.) are highly depleted in Os, an indication that many of the currently confirmed 176 impact structures on Earth could be related to MIPs.

References: [1] Janssens M.-J. et al. 1977. *Journal of Geophysical Research* **82**:750-758. [2] Palme H. 1980. *Proc. 11th Lunar Planet. Sci. Conf.* 481-506. [3] Schmidt G. et al. 1997. *Geochimica et Cosmochimica Acta* 61:2977-2987. [4] Tagle R. et al. 2008. *Meteoritics and Planetary Sciences.* [5] Rudnick R. L. and Gao S. 2003. *Treatise on Geochemistry* 3:1-64. [6] Palme H. and O'Neill, H. St. C. 2003. *Treatise on Geochemistry* 2:1-38. [7] Trinquier A. et al. 2008. *Geochim.Cosmochim. Acta* 72:5146-5163. [8] Goderis S. et al. 2009. *Chemical Geology* 258:145-156.