PROGRESS REPORT ON THE RE-EVALUATION OF THE CHESAPEAKE BAY AND POPIGAI CRATER IMPACT AGES: NEW ^{40}AR-^{39}AR STEP HEATING RESULTS FROM POPIGAI IMPACTITES.

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Introduction: As reported in our abstract for LPSC XLIII [1], our group is carrying out new measurements on impactites from the Chesapeake Bay (tektites and impact melt rock) and Popigai (impact melt rock) impact structures. The aim is to better constrain the time interval between these two impact events and others within the Eocene/Oligocene period. During the late Eocene at least 2 large and 2 smaller impact craters were formed on Earth: Chesapeake Bay (85 km Ø; 35.3 ± 0.1 Ma: [2]), Popigai (100 km Ø; 35.7 ± 0.2 Ma: [3]), Mistastin (28 km Ø; 36.4 ± 4 Ma: [4]), and Wanapitei (7.5 km Ø; 37.8 ± 1.6 Ma: [5]).]); and possibly also in the lunar craters Moore F and Byrgius A [6]. Coeval with the formation of these impact events, a 2 Ma increase in the flux of ^{3}He-rich extraterrestrial material occurred in the late Eocene [7]. These authors interpreted this as the result of a comet incursion, whereas [8, 9] preferred an asteroid shower as the cause. Here, we report preliminary results for 7 different impact melt samples from the Popigai crater [10].

Popigai impact structure: this crater has a diameter of ~100 km and is located north of Norilsk city in Siberia, Russia [11]. It is situated at the NE margin of the Anabar shield where Archean and Proterozoic gneisses, schists and igneous rocks are partly covered by sedimentary sequences of Upper Proterozoic, Cambrian, Permian and Cretaceous ages [12]. The result of this impact event includes highly shocked rocks, lithic impact breccias, suevites, and impact melt rocks (tagamites) [12]. The impactor has been modeled as an eight-kilometer-size asteroid [10] of L-chondritic composition [13]. Previous radiometric ages reported by [3] were obtained by ^{40}Ar/^{39}Ar step heating of impact melt rocks. The preferred age of 35.7± 0.2 Ma was based on a single plateau as these authors argued that other Ar releases were likely affected by inherited ^{40}Ar or perturbed by some mechanism not fully understood. More recently [14] recalculated the weighted mean of all four plateaux and two "mini"-plateaux. The best age estimate of 36.42±0.81 Ma is based on the four plateaux showing ~70% ^{39}Ar release [14]. The present work aims at improving the age determination for the Popigai impact and to better evaluate the effects of inherited argon and other disturbances (e.g., weathering alteration) affecting the Popigai impactites.

Samples and methodology:

For an improved re-evaluation of the age of the Popigai impact structure, we analysed impact melt rocks collected by Dr. Phillip Claeys (Vrije Universiteit, Brussels, Belgium) during an expedition in 1997. Out of a total of ~100 samples, seven samples were selected based on their macroscopic appearance regarding a high melt to clast ratio to minimize the argon contribution from target materials clasts. The large proportion of impact melt in these samples let us assume that these samples would be useful in reducing the amount of excess/parentless ^{40}Ar that can lead to an age overestimation. From all seven impactites ~2 mm thick-sections were prepared and melt and clastic constituents were carefully inspected and characterized using scanning electron microscope (SEM) and electron microprobe (EMP). In general, the impact melt rocks consist of a hypocrystalline groundmasses of mesostasis and feldspar and pyroxene microliths (Figs. 1 and 2).

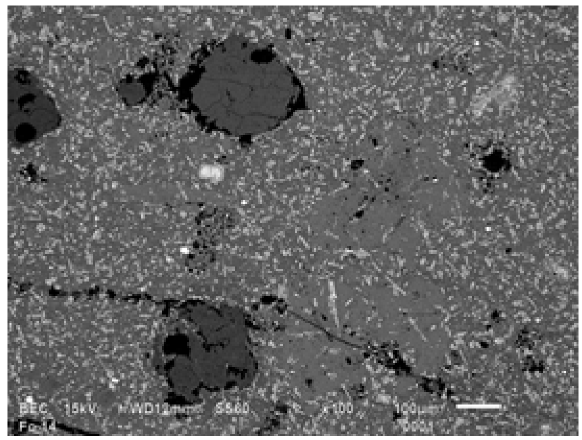

Figure 1 Typical Popigai impact melt (sample Fo-14) with hypocrystalline groundmass and ballen quartz clasts.

Most lithic clasts are derived from gneiss precursors. The most ubiquitous mineral component is quartz appearing either as unshocked or with undulatory extinction, PDFs or as a clast showing ballen-quartz texture [15]. In addition, for some of the samples, there were fragments of alkali-feldspar where some showed vesicles, hornblende, amphibole, phosphates, zircon, and pyroxenes with lamellae. Many of these clasts show reaction rims that formed during quenching of the surrounding impact melt. One of the impact melt rocks contains large, elongated vesicles up to 0.3 x 2 cm in size. To minimize contamination by weathering products, the sample material used for ^{40}Ar-^{39}Ar step heating was washed with diluted HNO_3 and rinsed with distilled water followed by drying at ~50°C for 12h. Impact melt samples and 14 aliquots from the neutron fluence monitor Bergell granodiorite biotite (HD-B1) were loaded into two vacuum sealed pure-silica vials. The two vials were irradiated at the Sacavém Reactor in Lisbon (Portugal) for 8 hours. Argon was extracted from samples by step heating using a high-frequency induction furnace at the University of Heidelberg (Germany).

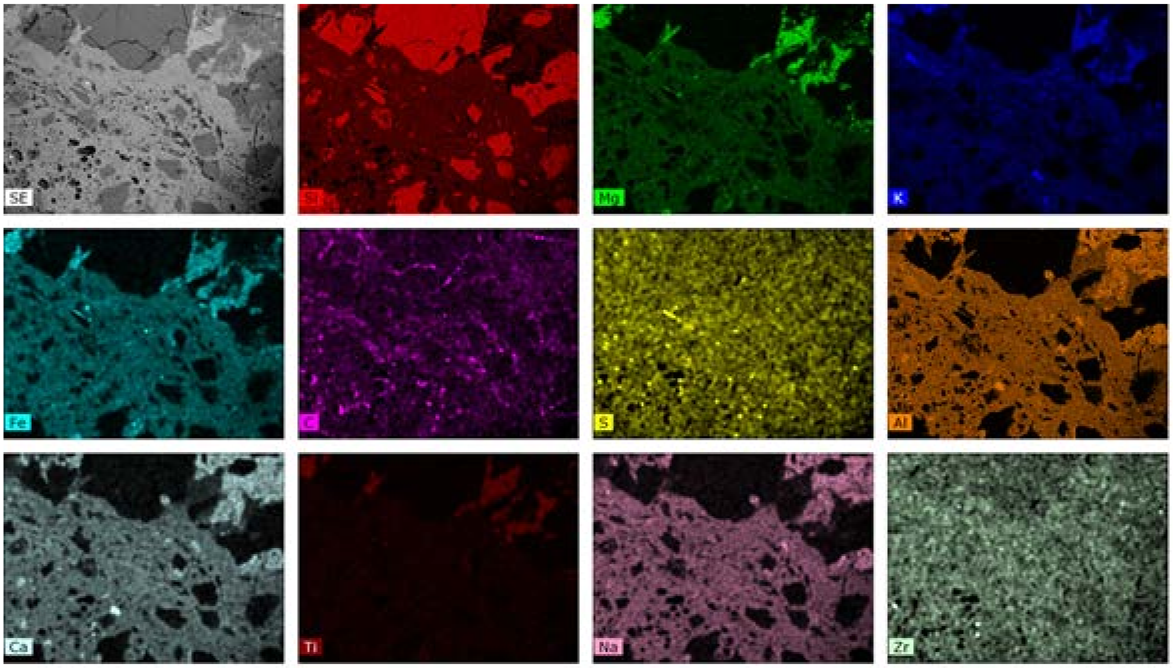

Figure 2 Elemetal maps of typical region in impact melt Fo-34. Note; groundmass relatively higher concentration of K than groundmass.

All data were corrected for background, blank, interference, and decay.

^{40}Ar/^{39}Ar step heating results: Here are reported preliminary ^{40}Ar/^{39}Ar step heating data obtained for four of the seven bulk Popigai impact melt samples selected. Data for 17 to 22 heating steps (e.g., Fig. 3) were obtained per sample. In general, the initial ~5% ^{39}Ar release shows low apparent ages followed by a rapid apparent age increase. The following 37-90% of the ^{39}Ar-release in the age spectra for the four impact melts shows a steady decrease in apparent age as heating temperature increases (e.g., Fig. 3). This is a characteristic effect of ^{39}Ar-recoil and probably directly linked to the fine-grained texture of the groundmass. Ages derived from these steps range between 30-40 Ma. The final high-temperature heating steps show a strong increase in apparent age from 96 to 365 Ma.

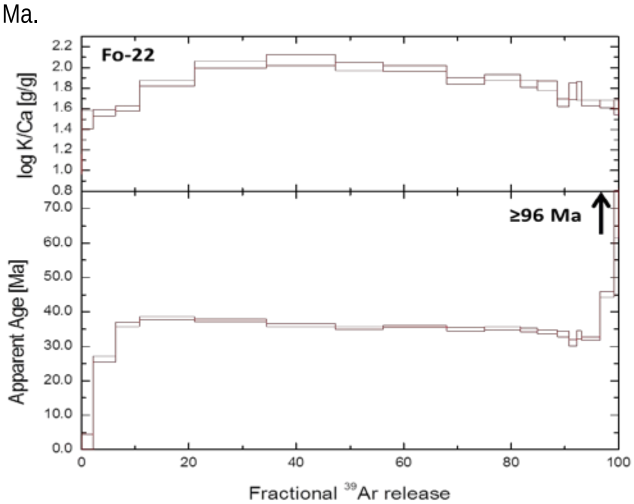

Figure 3 Results for Popigai impactite sample Fo-22: top) log K/Ca vs. fraction of ^{39}Ar released; bottom) Apparent age vs. fraction of ^{39}Ar release.

Summary: The careful inspection of the thick-sections obtained by SEM and EMP permitted the identification of areas composed mostly of impact melt groundmass material that were used for ^{40}Ar-^{39}Ar step heating experiments. The preliminary ages deduced for the samples range between 30-40 Ma, and more precise values will be obtained during the on going evaluation of the age-monitor irradiation parameters. However, it is already possible to conclude that the ages for the Popigai impactites analyzed in this study are similar to ages reported by [3 and 14]. Updated values will be presented at the conference. The data show little to no interference from excess/parentless ^{40}Ar. The older ages observed for the last heating steps at high temperatures are likely due to the release from target material of Archean to the Cretaceous ages.

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