Scientific drilling of the Boltysh impact crater, Ukraine

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INTRODUCTION

The Boltysh crater has been known for several decades and was first drilled in the 1960s as part of a study of economic oil shale deposits. Unfortunately, the cores were not curated and have been lost. We have re-drilled the impact crater and have recovered a near continuous record of ~400 m of organic-rich sediments together with 15 m of suevite. The sediments were deposited in a deep isolated lake and span a period ~10 Ma. The Boltysh impact crater, centred at 48°54’N and 32°15’E, is a complex impact structure formed on the crystalline basement rocks of the Ukrainian shield, which comprise porphyroblastic granites (age ca. 1.55 Ga) and biotite gneisses (age ca. 1.85 – 2.22 Ga) [1]. The structure is covered by Quaternary sediments and has been dated at 65.17±0.64 Ma [2]. At 24km diameter, the impact is unlikely to have contributed substantially to the worldwide devastation at the end of the Cretaceous.

PRELIMINARY FINDINGS

The lowermost 15m of the core is predominantly a polymict suevite breccia (Figure 2a). The clast size varies within the impact breccia on a mm to cm scale and there is extensive evidence of secondary hydrothermal activity. A sharp, 60°, angular contact marks the boundary between the impact breccia and the overlying sedimentary deposits (Figure 2b). The first sediments to be deposited in the crater lake occur at 581.5m and comprise a series of thin turbidite beds overlain by progressively more organic-rich shales and occasional oil shales (Figure 3). The 400 m of overlying sediments cover a period of approximately 10Ma. Preliminary palynological investigation indicates a number of significant floral and faunal transitions throughout the core and work is in progress to establish if the Cretaceous-Tertiary Boundary exists within the basal section of the core. Preliminary organic geochemical analyses of the core indicates variation in the distribution of hydrocarbons/biomarkers throughout the core caused by changing inputs and environmental conditions. The extracts from organic-rich sections of the core are commonly dominated by higher plant n-alkanes. Hopanes (including 3-methylhopanes) and steranes are also abundant and indicate a low level of organic maturity for the samples. The immaturity of samples is also evident from the abundance of hopanes, steranes and oleananes. Carbon isotopic analysis of the bulk organic material shows that there are a number of pronounced isotopic excursions in the first 100 m of core above the boundary (Figure 4).

PLANNED WORK

Work is in progress to complete the detailed palynological survey of the core and organic geochemical analyses. These studies will enable us to reconstruct the paleoenvironmental history of the post-impact environment at Boltysh and to examine the subsequent paleoenvironmental record preserved in the crater-fill sediments for a region of North Tethys where paleoenvironmental information is presently scarce.

REFERENCES


Figure 1: Location of Boltysh impact crater and estimated range of ejector layer.

Figure 2: A) Suevite containing glass veins and B) Boundary between impact breccia (on left) and overlying sediments.

Figure 3: Sedimentary log of bottom 100 m of Boltysh core.

Figure 4: Bulk organic δ13C values for crater fill sediments.