U/Pb zircon age of Mistastin Lake crater, Labrador, Canada – implications for high-precision dating of small impact melt sheets and the end Eocene extinction

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Accurate and precise dating of the impact cratering record on Earth is important for determining the duration of periods of intense bombardment and their role in causing climatic perturbations and biotic extinctions. Unfortunately only four terrestrial craters are well dated by the U-Pb zircon method; all are large structures, *ca*. 100–300 km in diameter [1]. We investigated the 28-km wide, Mistastin Lake crater [2], Labrador, Canada, in order to determine whether magmatic zircon forms in small-volume impact melt sheets and may be dated precisely and accurately. A sample was collected from Discovery Hill, an 80-meter thick, wedge-shaped butte of columnar-jointed impact melt rock. An age of 36 ± 4 Ma (2σ) for Mistastin was reported by [3] based on $^{40}Ar/^{39}Ar$ dating.

In addition to large elongated to equant (~100–500 μm) zircon inherited from the country rocks, the melt rock contains tiny, elongate (~25 μm wide x ~100–175 μm long), prismatic "needle" zircon with narrow, brown-colored melt channel "spines" running through the centers of the crystals. Eleven needles were analyzed by CA-TIMS using the EARTHTIME tracer solution. With only 1-4 pg of radiogenic Pb per needle, it was critical to have low Pb blanks (~0.4 pg) for high-precision dating. $^{206}Pb/^{238}U$ dates are equivalent with a weighted mean date of 37.83 ± 0.05 Ma (internal error, MSWD = 1.0) that is interpreted as the crystallization age of the impact melt. The results demonstrate that magmatic zircon can crystallize in impact melt from small craters. The new radiometric age for Mistastin makes it now the most precisely and accurately dated small crater on Earth. The Mistastin U/Pb date is significantly older than $^{40}Ar/^{39}Ar$ dates for the two largest (~100km) Eocene craters, Popigai (35.7±0.2 Ma, 2σ) and Chesapeake Bay (35.5±0.3 Ma, 2σ) [1] and the end Eocene mass extinction event (~34 Ma).

[1] Jourdon *et al*. (2009) *EPSL* **286**, 1-13. [2] Marion & Sylvester (2010) *Planet Space Sci* **38**, 552-573. [3] Mak *et al*. (1976) *EPSL* **31**, 345–357.

Modification of synthetic zeolites and characteristics of their properties

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Synthetic zeolites are increasingly likely to be used in advanced chemical processes and industry due to their attractive properties. Ongoing research is trying to establish a way improve some of their properties, for example, the process of sorption. This process is low because it takes place only on the outer surface of the crystallites. To increase the chemical affinity of the zeolite's surface to the organic compounds, modification of zeolites' surface is necessary. The aim of the study was to perform modifications of a synthetic zeolite and evaluate its sorption properties. The material used was an X-type zeolite prepared from coal fly ash. For modification of the zeolites' surface quaternary, ammonium salts with single or double carbon chain length, such as: dodecyltrimethylammonium bromide (DDTMABr), tetradecyltrimethyloammonium bromide (TDTMABr), hexadecyltrimethylammonium bromide (HDTMABBr) and octadecyltrimethylammonium bromide (ODTMABr) were used. Surfactants were adsorbed onto a synthetic zeolite in amounts of 1.0 and 2.0 of the external cation exchange capacity (ECEC) in quantities of 24.4 and 48.8 mmol per 100g of zeolite respectively. Quantitative characterization of organo-zeolites and characterization of their properties has been performed. The effectiveness of the modification has been determined based on the content of carbon, hydrogen and nitrogen combined with X-ray Diffraction and IR spectroscopy. Simultaneously, the effectiveness of maximum sorption capacity on organo-zeolites in terms of organic compounds such as benzene, toluene, xylene has been established. The results obtained show an improvement of the sorption properties of the organo-zeolite modified in an amount of 2.0 ECEC in relation to the 1.0 ECEC and unmodified material. Also the carbon chain length surfactants show their importance during the modification. The results of this research can be used in environmental protection and for further studies into the properties of surfactant-modified synthetic zeolites and their potential industrial applications; for example, in petrochemistry.

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