The granite basement of the Chicxulub impact structure peak ring: petrography and geochemistry

Feignon, Jean-Guillaume; De Graaff, Sietze Jan; Ferrière, Ludovic; Kaskes, Pim; Dehais, Thomas; Goderis, Steven; Claeys, Philippe; Koeberl, Christian

Published in:
Granitoids, continents, life and puns: A tribute to Hervé Martin - Abstract Volume

Publication date:
2023

Document Version:
Final published version

Granitoids, continents, life and puns
A tribute to Hervé Martin - Clermont-F^{d} 5-8th 2023

The granite basement of the Chicxulub impact structure peak ring: petrography and geochemistry

JEAN-GUILLAUME FEIGNON[1], SIETZE J. DE GRAAFF[2], LUDOVIC FERRIÈRE[3], PIM KASKES[1,4], THOMAS DÉHAIS[1,4], STEVEN GODERIS[1], PHILIPPE CLAEYS[1], AND CHRISTIAN KOEBERL[5]

[1]Analytical, Environmental & Geo-Chemistry, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium. Mail: Jean-Guillaume.Feignon@vub.be.
[2]Nederlandse organisatie voor wetenschappelijk onderzoek (NWO), Laan van Nieuw Oost-Indië 300, 2593 CE Den Haag, Netherlands.
[3]Natural History Museum Vienna, Burgring 7, 1010 Vienna, Austria.
[4]Laboratoire G-Time, Université Libre de Bruxelles, Av. F. D. Roosevelt 50, 1050 Brussels, Belgium.
[5]Department of Lithospheric Research, University of Vienna, Althanstrasse 14, A-1090 Vienna, Austria.

A unique feature of complex impact crater formation is to move target lithologies from depth to the surface in the form of central uplifts or peak rings, providing insights into the nature and composition of the subsurface in the impact area. For the first time, a large, nearly continuous crystalline basement unit (~600 m thick), was recovered within the Chicxulub impact structure (200-km-diameter, ~66.05 Ma) peak ring, which was drilled during the joint IODP-ICDP Expedition 364 in 2016. The bulk of the basement consists of pervasively deformed, fractured, and shocked granite. This offered a unique opportunity to constrain the chemistry and sources of the granite; how it was affected by the impact event; and to refine the Yucatán Peninsula basement geology. Detailed petrographic and geochemical investigations of 41 granite samples, including Sr-Nd isotopic analyses for 16 samples, were conducted.

The granite is mainly equigranular, coarse-grained, and holocrystalline. The bulk mineral assemblage (grain size from ~0.5 to ~4 cm) consists of orange to brownish K-feldspar (orthoclase, ~25-50 vol%), plagioclase (~15-35 vol%), quartz (~15-35 vol%), and, to a lesser extent, biotite (~1-5 vol%, commonly chloritized).

The granites are relatively homogeneous in terms of major (66.7-77.5 wt% SiO_2) and trace element compositions, and are different compared to felsic clasts recovered within other drill cores from the Chicxulub. The granites are part of the high-K, calc-alkaline metaluminous series, and have high

This abstract is too long to be accepted for publication. Please revise it so that it fits into the column on one page.

Sr/Y and $(La/Yb)_N$ ratios, which are typical for adakitic rocks. However, other criteria (such as Al_2O_3, MgO, and Ni contents, Mg#, K_2O/Na_2O ratio) do not match the adakite definition.

These results are consistent with previous studies, supporting that the granite intruded the Maya block during the Carboniferous, in a volcanic arc setting with crustal melting of a minor Grenvillian component (according to initial $(\varepsilon_{Nd})_{t=326Ma}$ (from -4.0 to +3.2) and the $T^{Nd}_{DM(t=326Ma)}$ model ages of ~1.1 Ga), related to the closure of the Rheic Ocean during the assembly of Pangea. Then, the granite was altered/deformed by two distinct hydrothermal events: (1) a hydrothermal metasomatic event, possibly related to the first stages of Pangea breakup (~273±21 Ma, according to Rb-Sr errorchron and initial $^{87}Sr/^{86}Sr_{t=326Ma}$ compositions), and (2) the post-impact hydrothermal alteration linked to a long-lived (>1 Myr) hydrothermal system within the Chicxulub impact structure.

The details of this study were published in Feignon et al. (2021, *Meteoritics & Planetary Science*, 56, 1243–1273, doi: 10.1111/maps.13705) and are dedicated to the memory of Hervé Martin.