DETERMINATION OF SHOCK-WAVE PEAK PRESSURE AND Rb-Sr ISOTOPE SYSTEMATICS IN A GRANITE FROM THE ARAGUAINHA IMPACT CRATER (BRASIL); I. Martinez, U. Schärer, Lab. de Géochronologie, Univ. Paris VII, 2 place Jussieu, 75251 Paris Cedex 05, France and A. Deutsch, Inst. f. Planetology, Univ. Münster, Wilh. Klemm Str. 10, D-4400 Münster, Germany.

In the context of systematic evaluations of shock-wave effects on minerals and isotope systems, a highly impact brecciated alkali-granite from the Araguainha crater was investigated. This crater forms an about 40 km diameter circular structure in the Palaeozoic sediments of the Parana basin (e.g. 1,2), where the 6.5 km wide shocked granite occurs in the uplifted center of the crater. Collected in the core of the granite, the samples show the following microscopical features:

- individual minerals can still be identified
- quartz shows brown color, and displays planar structures
- plagioclase is very fractured, often with very fine-grained polycrystalline, almost isotropic aggregates in the center of the grains
- biotite is characterized by kink-bands
- K-feldspar shows mosaicism.

Using the criteria established by Stöffler (3), these features indicate that peak shock pressures did not exceed 40 GPa. In order to determine a precise shock pressure for the granite, typically shocked individual grains were studied by the spindle-stage method of Medenbach (4), which offers the two main advantages that the crystals can very precisely be orientated, and that the absolute index of refraction is determined via a calcite crystal of well known index. Based on this technique, for quartz and feldspar a strong correlation between refractive indexes and shock pressure has been established (e. g. 5-7), shown for quartz in Fig. 1. Moreover, the immersion cell can be heated or cooled, allowing application of the λ-T variation method and hence, the construction of dispersion curves for solids. Spindle-stage measurements of the granite were performed on individual, about 200 µm size quartz and albite grains. Prior to measurements, the chemical composition of the very same grains was analyzed by EDS.

Results: For shocked *quartz*, the following refractive indexes were measured: (λ= 589 nm) n_0 = 1.5402 and n_e = 1.5489 (Fig.1), where the indexes o and e stand for the ordinary and extraordinary waves, respectively. Errors on these measurements are on the order of ± 0.03%. The corresponding birefringence value of 0.0087 is not very different from that of unshocked quartz indicating that shock-wave pressures were lower than 30 GPa (Fig. 1). On the other hand, the refractive indexes (n_0 and n_e) substantiate a peak pressure in excess to 25 GPa, and the combined data constrain the pressure to be 27 ± 1 GPa (Fig. 1).

For shocked *albite*, the three refractive indexes are: n_x = 1.5296, n_y = 1.5316, n_z = 1.5411, giving a value of 0.0115 for birefringence. These optical properties are close to those of unshocked albite. It has been shown (e.g. 8,9) that different plagioclases, i.e. bytownite, labradorite, oligoclase loose their birefringence at 24, 26 and 30 GPa, respectively. By simple extrapolation from these data (Fig. 2), a maximum shock pressure of less than 32 GPa can be determined, being in good agreement with the 30 GPa limit defined by the quartz data.

Fig. 3 shows a Rb-Sr isochron diagram for different minerals from the 27 ± 1 GPa shocked granite (sample A 235f) , in comparison with data obtained from an impact melt rock (sample A 300), consisting of a fine-grained crystalline matrix and quartz, albite, K-feldspar and some tiny biotite grains. For the melt rock, two feldspar fractions, the W.R. and the cordierite define an isochron age of 243 ± 19 Ma (2σ), which is interpreted to data the impact event, although cordierite shows retrogradation to sericite (9). This age is compatible with both the Permian age of the youngest sediments (< 290 Ma) affected by the impact, and the probably pre-Jurassic age (> 210 Ma) of cross-cutting dikes. In contrast to the melt rock from the Araguainha crater, a regression line through albite+quartz, biotite, W.R. from the 27 GPa

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shocked granite yields a significantly older isochron age of 449 ± 9 Ma (2σ), indicating that disturbances of the Rb-Sr system in the granite minerals, in particular biotite are very small or even absent. This is consistent with the good fit of the isochron, and the age most likely dates primary closure of the Rb-Sr system during solidification of the magma. The Rb-Sr age of 449 Ma is significantly older than an earlier K-Ar age of 362 ± 13 Ma for kinked biotite of the granite (10).

The Rb-Sr data from the 27 GPa shocked alkali granite from the Araguainha crater corroborate previous results from shock-recovery experiments and dating results from the Houghton crater (11,12) showing that impact induced Rb-Sr fractionation is very limited at shock pressures of 27 GPa, although crystal lattices of individual minerals are severely damaged. Moreover, the date confirm that the K-Ar system is significantly more sensitive, being partly reset at the same pressure-temperature conditions.

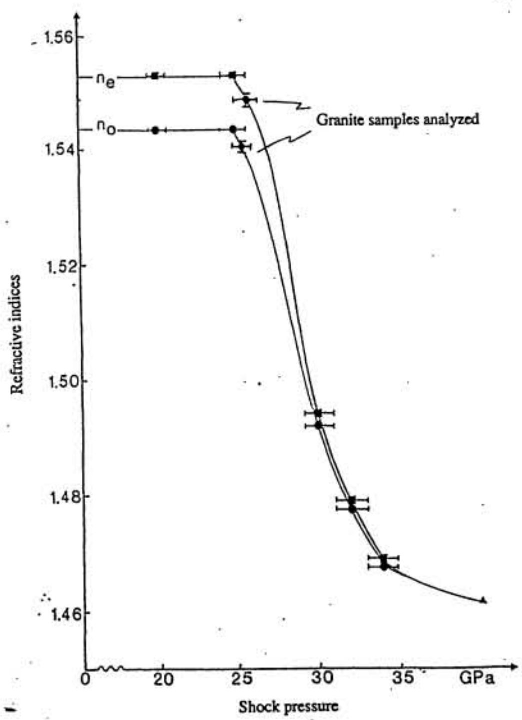
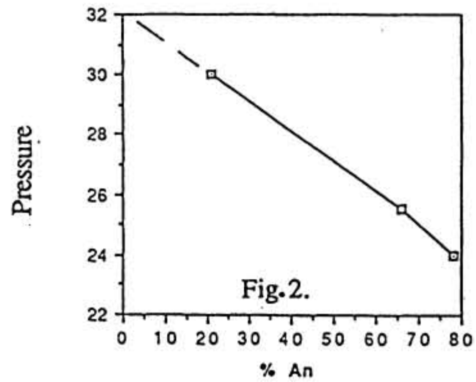
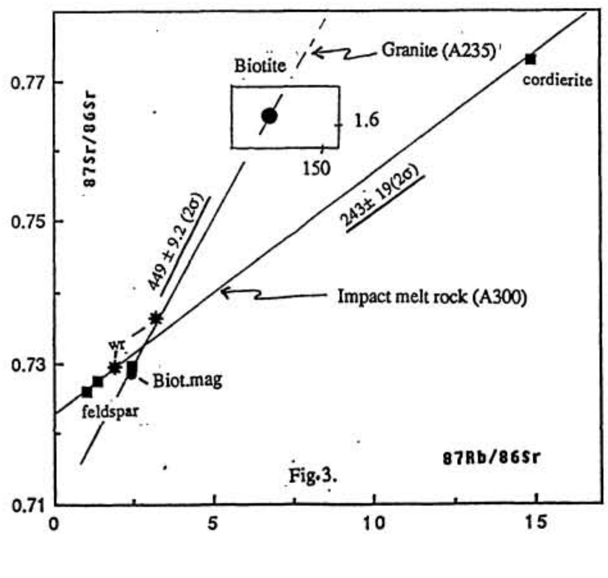


Fig1: Variation of refractive indices n_o and n_e in quartz crystals as a function of shock pressure; after (5-7).





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