Geophysical Research Abstracts
Vol. 13, EGU2011-335, 2011
EGU General Assembly 2011

The Poços de Caldas alkaline massif, a key to understand thermal, exhumation, rock and surface uplift history at the "passive" continental margin of Brazil.

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The present data constrain the pattern and history of exhumation of the Poços de Caldas alkaline massif (PCAM) and surrounding area since the Carboniferous. The PCAM (∼83 Ma intrusion age) is a semi-circular feature with a nearly flat plateau (average elevations of ∼1300 m.a.s.l.) in the interior. Nearly all borders of the plateau are surrounded by topographic ring features that reach more than 1600 m.a.s.l. In the West, the Neoproterozoic basement occurs at elevation of about 750 m. Five AFT samples of the alkaline massif range in age from 69.0 (4.4) Ma to 42.7 (3.4) Ma and one AFT sample of a Neoproterozoic foliated granite provide an age of 101.3 (5.4) Ma. Color selected zircon concentrates of the foliated granite and the Lower Cretaceous Botucatu sandstone revealed ZFT-ages between 254.9 (19.4) Ma and 424.2 (39.6) Ma. Colorless to white and yellow zircon of the Botucatu sandstone are much younger than the red colored zircon grains. AHe-ages are in the range of 47.1 (5.8) Ma to 84.1 (4.4) Ma. ZHe-ages cover the age range between 534.0 (42.7) Ma and 83.5 (3.8) Ma. Application of system filters lead to a reliable AHe age of 47.1 (5.8) and ZHe-ages of 293.6 (1.3) Ma for the Neoproterozoic foliated granite. The Botucatu sandstone provided a reliable ZHe-age of 78.7 (0.4) Ma. Two samples of the alkaline massif revealed each two reliable zircon grains with an age range from 89.1 (7.1) Ma to 83.6 (6.7) Ma. The thermochronological cooling history of rocks exposed in the PCAM reveals that the faster cooling and main exhumation process occurred shortly after the intrusion of the alkaline magma (83 Ma) and lasted for about 11 Myr until about 72 Ma. This very fast cooling is partly contributed by the heat dissipation of the hot magmatic rocks to the surrounding colder Neoproterozoic foliated granite (∼ 100 °C at ∼80 Ma) and an erosion of about 2,000 m of volcanic and subvolcanic rocks. The erosion leads to a topography with elevation differences of about 200 m in the PCAM. During the Late Cretaceous (∼ 70 Ma) and Early Paleogene (∼45 Ma) the exhumation nearly vanished. The exhumation rate decreased to 0.005 mm/a with an average of about 100 m erosion. The presented thermochronological data set do not support the formation of the "South American Planation Surface" during the Late Cretaceous to Early Paleogene. At the proposed time range the thermochronological data set indicates a rock column of more than 2,000 m thickness above the recent sample locations. Thermochronological modeling clearly indicates that near recent surface temperature conditions were reached at about 40 Ma in the north of the PCAM and at about 35 Ma in the southwest of the massif. Therefore, the nearly flat plateau of the PCAM has been formed in the time range between 45 and 35 Ma and was stable thereafter. The climate evolution from a dry episode of tropical climate in the Paleocene (65 - 55 Ma), followed by a humid climate with associated chemical weathering in the Eocene (55-36 Ma), and drier conditions during the Neogene (23-2 Ma) could explain the change in exhumation rates. Nevertheless, the structural reorganization of the passive continental margin in Eocene to Oligocene time could also account for the change in exhumation rates.