

U-Pb dating of detrital zircon: a case study in the Pedra de Fogo Formation, Permian of the Parnaíba Basin

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Provenance analysis using U-Pb dating of detrital zircons is a technique widely applied in studies of the evolution of sedimentary basins. A case study in the Pedra de Fogo Formation, Permian of the Parnaíba Basin, was carried out to produce novel U-Pb data in detrital zircons for this formation integrating with previous formation data from the basin. The description of two stratigraphic sections – BS 14 and BS 07 – performed by the team of the BIOCRONORTE Project provided the characterization of fluvial-lacustrine intervals in the lower part of the Pedra de Fogo Formation in the Floriano region (Piauí, Northeast of Brazil). Representative sandstone samples were collected for U-Pb dating (sample PR-19 in section BS 14 and sample PR-14 in section BS 07). The zircon concentrates were obtained using pan concentration, Frantz isodynamic magnetic separator, and heavy liquid (Dilodromethane). The U-Pb age analyses were performed at the Geochronological Research Center at the University of São Paulo on a Thermo-Fisher Neptune inductively coupled plasma mass spectrometer (ICP-MS) connected with an Excimer ArF laser ablation system (LA) of 193 nm wavelength. Corrections of mass bias were performed by the analysis of zircon standard GJ-1. The acquired data were filtered, removing analyses above 10% of discordance and those with more than 10% of common lead. For plotting, the $^{207}\text{Pb}/^{206}\text{Pb}$ age was used for grains older than 1.2 Ga and $^{206}\text{Pb}/^{238}\text{U}$ age for grains younger than 1.2 Ga. The signatures in KDE (Kernel Density Estimator) plots of the detrital zircons of the PR-19 sample indicated three peaks of predominant contributions: (i) Orosirian-Rhyacian (1800 to 2300 Ma), (ii) Tonian-Stenian (720 to 1200 Ma), and (iii) Ediacaran-Cryogenian (538 to 720 Ma). On the other hand, the analysis of the PR-14 sample signatures highlighted only two significant contributions: (i) Orosirian (1800 to 2050 Ma) and (ii) Ediacaran-Cryogenian, although Tonian ages were present. The small number of analyses in this sample may have hampered the expression of this contribution. Comparing the results with previous data from the basin, it was found that the signatures are similar to those of other units in the Parnaíba Basin. However, the presence of Ectasian-Calymmian zircons (1200 to 1600 Ma) in the PR-14 was considered an unusual signature related to the sedimentation environment and/or local variations, perhaps involving recycling. Further studies to evaluate the influence of the sedimentation paleoenvironment on the U-Pb detrital zircon signatures of the Pedra de Fogo Formation are recommended. Another relevant data was the identification of one zircon with an age of 273 Ma, which, although consisting of a single grain, motivates further studies addressing a contribution on the age of deposition for this formation, which would be very meaningful for the Parnaíba Basin evolution.

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