A 'SPEEDY' UNSPIKED K-AR TECHNIQUE APPLIED TO MESOZOIC MAFIC ROCKS

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RESUMO: The unspiked K-Ar technique was developed as an operational procedure that enables measurements of argon isotopic compositions without the 38Ar tracer, accomplished by comparing the intensity of the 40Ar signal of the unknown sample with that of an atmospheric 40Ar reference (the air pipette). The pressure inside the ultra-vacuum system must be well controlled so that the isotopic Ar measurements from both the air pipette and the unknown samples are made under the same conditions. The K content, in turn, is obtained from whole rock geochemical analysis as performed on the conventional K/Ar method. The step heating 40Ar/39Ar method, conversely, allows a direct measurement of parent and daughter radionuclides by inducing the conversion of K to 39Ar during irradiation of the sample on a nuclear reactor, and analyzing all Ar isotopes at the same time on the mass spectrometer. Even though the 40Ar/39Ar method is an established dating methodology all-around, the unspiked K/Ar is used mainly on near-zero age rocks and its use as a dating tool for Mesozoic rocks is still unproven. In this work, a 'speedy' unspiked K-Ar technique was developed to constrain ages of dolerites constituting two giant dike swarms from the Equatorial Atlantic Magmatic Province (EQUAMP; ca. 130Ma) in NE Brazil. The EQUAMP is a Large Igneous Province (LIP) correlated to the breakup of the West Gondwana supercontinent and opening of the Atlantic Ocean during the Early Cretaceous. Because these dike swarms have very large (>300 km long) dimensions and lack geochronological information, we applied the unspiked K-Ar methodology as an investigative tool to rapidly uncover age patterns along the swarms before using other high-resolution techniques. The results obtained in more than 100 samples were interpreted considering basic regression statistics, and the main conclusions were twofold. First, the results indicated two main age intervals of geological significance – in the Late Jurassic and Early Cretaceous. Second, our data match age intervals defined by both conventional K-Ar and 40Ar/39Ar methods reported for other mafic rocks related to the Gondwana breakup in South America. Simultaneously, we dated 17 samples by the 40Ar/39Ar method on a neighboring sill province in the eastern flank of the Parnaíba Basin, immediately westward of the dikes. The same results were described in the sills, where two important igneous manifestations are recognized and dated synchronically to the ones found by the unspiked K/Ar technique. Unfortunately, the unspiked technique has some issues when applied to non-aphyric mafic rocks, which are mainly related to (micro) sampling inhomogeneity related to misestimation of K concentration in mg-sized aliquots, a matter that needs to be carefully examined before considering the adoption of this 'speedy' analytical protocol as a dating technique instead of an investigative tool, as adopted in this study. Nonetheless, the similarity in ages with the more precise 40Ar/39Ar method allow us to characterize the age intervals of two LIPs on both the dikes and sills, the CAMP and the EQUAMP, related respectively to the Pangea and Western Gondwana breakup during the Mesozoic Era.

PALAVRAS-CHAVE: GONDWANNA BREAKUP, NOBLE GAS DATING, DIKE SWARMS.