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Recalibration of the Rb decay constant by age comparison against three U-Pb dated igneous rocks

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In 1977, the Subcommision on Geochronology [1] proposed a Rb decay constant (λ^{87}Rb) of 1.42 x 10^{-11}/a with a potential precision at the percent level at best [2]. Subsequently, this value was used in almost all Rb-Sr studies. Over the last two decades, several attempts to refine λ^{87}Rb by different techniques yielded results that, despite excellent reported precisions, differed from the proposed value and also from each other. In a recent evaluation of published calibrations of the decay constant, Begemann et al. [2] suggested a significantly lower value [$\sim$ 1.40 x 10^{-11}/a] but also called for a re-determination of λ^{87}Rb percent to check its accuracy and significantly improve the precision. Two subsequent attempts [3,4] have also yielded values that differ significantly from that proposed by the Subcommision on Geochronology [1]; unfortunately one value is higher [3], and the other one lower [4] than the recommended value. Therefore, at present, there is still no consensus on which λ^{87}Rb should be used in Rb-Sr chronology.

Here, we report three individual determinations of λ^{87}Rb by the method of age comparison. This entails solving for λ^{87}Rb using 1) the measured slopes of high precision Rb-Sr isochrons from igneous rocks and minerals and 2) the emplacement ages of these samples as determined by the precise and accurate U-Pb method. The precision of the measured ^{87}Rb/^{86}Sr has been improved to $\sim$ 0.2% by measuring Rb concentrations by isotope dilution MC-ICPMS [5] (cf. $\sim$1% for TIMS data). A challenging aspect of Rb-Sr studies is that of spike calibration, which is generally done using standards prepared from salts of Rb and Sr rather than pure metals. The Rb/Sr values of individual spikes calibrated against two standard solutions made from different salts (iodide and carbonate) agree to within 0.15%, strongly suggesting that the stoichiom-

etry of the salts, after careful dehydration, is ideal enough for accurate spike calibrations. The Rb-Sr systematics of the Klokken Intrusion, Greenland, the Bolgokthokh Intrusion, Siberia, and the Phalaborwa Carbonatite, South Africa, yield a weighted mean λ^{87}Rb of 1.399$\pm$0.003x10^{-11}/a. This constant is 1.5% lower than the currently accepted value from [1], but in agreement with those of [4] and [6]. If this lower value proves to be accurate, Rb-Sr cooling or emplacement ages calculated with the value of 1.42 x 10^{-11}/a are 1.5% too low and need to be reconsidered in terms of their geologic interpretation. The decay constant from our study has a precision of $\pm$0.25%, allowing the precision of Rb-Sr ages to approach that attainable with other chronometers such as U-Pb or Lu-Hf.

References: [1] Steiger and Jäger (1977), EPSL 36(3), p.359; [2] Begemann et al. (2002); GCA 65(1), p.121; [3] Rotenberg et al. (2005) GCA 69(10); A326; [4] Kossert et al. (2003) Ap.Rad. & Isot. 59(5-6,) p.377 [5] Nebel et al. (2005) IntJourMassSpec.246 p.10; [6] Minster et al. (1982) Nature 300