# Decay constant uncertainties in isochron

YUMENG LIU AND TIANYI LU

State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China (hannibal6274@gmail.com)

The uncertainties in decay constant have received less attentions despite of the increasing applications of various radiometric systems in diverse rocks.At present, multiple radioisotope dating methods are increased in demand for more precise results and easily interpreted comparison. As many geologists and geochronologists have realized that the precision of radioisotopic ages is limited by the accuracy of radioactive decay constants, they have to take systematic errors due to large uncertainties in the decay constants into consideration for obtaining smaller errors and higher precision dating data which is often ignored or unclear in many cases most probably because the uncertainties in the decay constants are not in a quantitative sense.

In this study we have investigated some published data which did not consider the influence of radioactive decay constants on errors as well as some age comparison based on different radioisotope dating methods. The value of the Lu-Hf decay constant is calculated from the relationship $\lambda^{176} = \ln(m+1)/t$, where m equals the slope of the Lu-Hf mineral isochrone and t is the age constrained by U-Pb. According to the error propagation formula, we obtain a simple and easy formula omitting errors caused by isotope ratio measurements: $\sigma_t = \sigma_\lambda/\lambda * t$ , where $\sigma_t$ means age error and $\sigma_\lambda$ is the uncertainty of decay constant. Therefore, We can easily obtain a linear relationship between age error and minerals formation age or geological events age.

On the tectonic scale of 4600Ma, age error and formation age of minerals or geological events age is linear and positive. When the tectonic scale extends to billions of years, age errors from Lu-Hf and Sm-Nd isotope ratio measurements both remain approximately constant during the period, 270Ma and140Ma respectively.At this point,age error is mainly controlled by the uncertainty of decay constant.Age errors from Lu-Hf and Sm-Nd mineral isochrones are more easily influenced by decay constants. For every 234Ma and 131Ma add in age, the age errors increase 1 Ma. Particularly when the actual age of minerals or geological events is less than 200Ma, each time d/p ratio adds 0.2, the age error from Lu-Hf increases approximately 1Ma.

We call for a concerted effort to achieve improvements on complicated calculation of error propagation.