Issues to be considered for dating young samples by the U-Pb and K-Ar(Ar-Ar) methods

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In recent years, due to the remarkable development in mass specrometry such as ICP-M and SIMS, the available dating range of U-Pb method by using zircon has been enlarged to such a young age as below 1Ma. Hence, for young volcanic rocks which has been dated by mainly K-Ar(Ar-Ar) methods so far, the zircon U-Pb age might be sometimes used. However, since the amount of radiogenic isotope is poor

In the U-Pb dating, zircon is commonly used and zircon is tough against secondary effects. Further, it has a merit that such effect is evaluated by using the concordia plot under a favorable condition. in-situ analysis is also possible for a single zircon grain. It is likely that samples with ages exceeding several tens of million years, a zircon U-Pb age would represent more approximate formation age compared a K-Ar age which is sensitive to the secondary effect.

Since zircon is formed in an acidic magma, however, it is very difficult to find it in basic rocks such as basalt and gabbro. In the oceanic area, volcanic rocks are almost basaltic ones. Hence, the usage of zircon is very limited for samples in this area. On the other hand, K-bearing minerals are widely distributed in both oceanic and continental areas. Thus, the K-Ar method is quite useful in this respect. By applying the K-Ar system-based Ar-Ar dating method with the stepwise heating, it is possible to get a reliable formation age even if excess afor a sample with secondary effects. Further, bythe unfractionated applying laser ablation, it is possible to in-situ analysis within a grain.

For a sample with less than 1Ma, in the case of K-Ar(Ar-Ar) method, one should consider such issues carefully as the reasonaable conditions for the air correction and the occurrence of excess 40Ar. We have known that the atmospheric 40Ar/36Ar might be fractionated when magma erupted on the surface. This might be corrected by comparing the observed 38r/36Ar in a sample with that of the unfractionated it might be possibl However, if excess 40Ar exists, this assumption cannot be applied. Hence, although it might be possible to get a K-Ar age value for a basaltic sample with even less than 10ka technically, it might be more conservative to say that around a few tens ka might be a younger limit as as a reliable K-Ar age of a basaltic rock.

In the case of zircon U-Pb age of a sample with less than 1Ma, there are several issues to be considered such as the correction for common Pb and inherited Pb in addition to the disequilibrium issue between the 238U-206Pb and the 235U-207Pb systems. To correct for common Pb, the 206Pb/204Pb and the 207Pb/204Pb of the inferred common Pb are used based on the observed stable isotope 204Pb. However, since the amount of 204Pb is relatively low, it is not easy to measure it precisely. Hence, it is quite likely that the inferred radiogenic Pb might be accompanied with relatively large uncrtainties. Furthermore, it is still not clear how long it takes to form a zircon crystal in a magma. Hence, it is not always guaranteed that a zircon U-Pb age reflects an eruption age of magma. If the U-Pb system is not in equilibrium, the model in the concordia plot is not hold. Such issues are more sensitive for young samples with less radiogenic isotopes. Hence, we must treat a zircon U-Pb age very carefully for a sample with less than 1Ma.

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