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Progress on Zircon U-Pb Dating Technique

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U-Pb isotopic dating is one of the earliest developed geological dating techniques.The zircon U-Pb dating has many advantages compared with other isotope dating techniques.Zircon is one of the most common accessory minerals in igneous rocks,metamorphic rocks and sedimentary rocks.For rich in U and Th,very low ordinary Pb content and high physical and chemical stability,high blocking temperature of isotope system (Lee et al., 1997),it is the ideal object to determine the magmatic crystallization age and peak age of senior metamorphism,at the same time the zircon in sediments U-Pb age spectrum test is also helpful to source tracer (Yan et al., 2003).

Zircon U-Pb isotope dating technique is developing in the high time resolution (high-precision) (Schmitz et al., 2013) and high spatial resolution (Nemchin et al., 2013).The former uses isotope dilution-thermal ionization mass spectrometry (ID-TIMS) to analysis U-Pb isotopic composition of the solution of single particle or part of zircon particle calibrated by tracer.The latter dates the zircon U-Pb ages of different regions by in situ micro-analytical techniques such as secondary ion mass spectrometry (SIMS) and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) which are based on the prototype correction (Yang et al., 2014).

ID-TIMS method at present is still the most accurate and reliable method which doesn't need the prototype correction(deviation can be at or better than 0.1%),with the most widely applicable age range,its limitations are mainly unable to carry out the zircon micro zone in situ U-Pb isotopic age dating,for complex genesis of zircon its geological age is often not clear,needing to dissolve the sample,and the U-Pb separation and pretreatment process is relatively complex,and requires very low experiment background.

The advantage of which we date U-Pb isotopic age of various minerals containing uranium method by SIMS is,it also can be in situ zircon U-Pb isotopic dating.Neither need to dissolve minerals,nor need chemical separation,small damage to the sample (beam spot generally is 10~30 microns,the sampling depth is about 1 micron) ,and a high spatial resolution,but expensive instruments purchase,slow speed of analysis and the high cost of testing.

LA-ICP-MS method is the same as SIMS method,it also can be performed in situ U-Pb zircon isotopic age dating,and the required equipment is much more simple,cheaper,and faster dating speed.Compared with the method of SIMS,one of the limitations of mineral U-Pb isotopic dating by LA-ICP-MS method is,the lower measurement sensitivity,much more damage to the sample (beam spot generally is 30~40 microns,the sampling depth is approximately 20~30 microns).Developed in recent years the laser ablation multicollector inductively coupled plasma mass spectrometry (LA-MC-ICP-MS) technique improves the test accuracy and can even be comparable with SIMS data (Hou et al., 2009; Geng et al., 2012).

Therefore,reasonable interpretation of zircon U-Pb ages can be effectively constrained by its internal structure,trace element feature,mineral inclusion composition and so on which distinguish the genesis of zircon and its formation environment (Jian et al., 2001; Wu et al., 2004; Lei et al., 2013).

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