# 第一章 U-Pb 同位素定年方法描述

## 1.1 锆石 LA-ICP-MS 微区原位 U-Pb 定年和微量元素分析（Tanz）

锆石 U-Pb 同位素定年和微量元素含量在武汉上谱分析科技有限责任公司利用 LA-ICP-MS 同时分析完成。有关详细的仪器参数和分析流程见 Zong et al. (2017)。GeolasPro 激光剥蚀系统由 COMPexPro 102 ArF 193 nm 准分子激光器和 MicroLas 光学系统组成，ICP-MS 型号为 Agilent 7900。激光剥蚀过程中，采用氦气作载气，氩气为补偿气以调节灵敏度。二者在进入 ICP 之前通过一个 T 型接头混合，激光剥蚀系统配置有信号平滑装置(Hu et al., 2015)。本次分析的激光束斑和频率分别为××μm 和××Hz。U-Pb 同位素定年和微量元素含量处理中，使用锆石标准 Tanz 和玻璃标准物质 NIST610 作为外标，分别进行同位素和微量元素分馏校正(Hu et al., 2021)。每个时间分辨分析数据包括 20-30 秒空白信号和 50 秒样品信号。对分析数据的离线处理（包括对样品和空白信号的选择、仪器灵敏度漂移校正、元素含量及 U-Pb 同位素比值和年龄计算）采用软件 ICPMSDataCal (Liu et al., 2008; Liu et al., 2010)完成。对锆石样品的 U-Pb 年龄谐和图绘制和年龄加权平均计算采用 Isoplot/Ex_ver3 (Ludwig, 2003) 完成。

*注：岩石薄片中锆石 U-Pb 同位素定年参考 Zong et al. (2010)。××代表实验中激光束斑和频率的数值，根据具体实验条件填写。锆石常规分析条件为 32 μm 和 5 Hz。*

## 1.1 In-situ U-Pb dating and trace element analysis of zircon by LA-ICP-MS（Tanz）

U-Pb dating and trace element analysis of zircon were simultaneously conducted by LA-ICP-MS at the Wuhan SampleSolution Analytical Technology Co., Ltd., Wuhan, China. Detailed operating conditions for the laser ablation system, the ICP-MS instrument, and data reduction are the same as described by Zong et al. (2017). Laser sampling was performed using a GeolasPro laser ablation system that consists of a COMPexPro 102 ArF excimer laser (wavelength of 193 nm and maximum energy of 200 mJ) and a MicroLas optical system. An Agilent 7900 ICP-MS instrument was used to acquire ion-signal intensities. Helium was applied as a carrier gas. Argon was used as the make-up gas and mixed with the carrier gas via a T-connector before entering the ICP. A “wire” signal smoothing device is included in this laser ablation system (Hu et al., 2015). The spot size and frequency of the laser were set to ××μm and ××Hz, respectively, in this study. Zircon Tanz and glass NIST610 served as external standards for U-Pb dating and trace element calibration (Hu et al., 2021),

respectively. Each analysis incorporated a background acquisition of approximately 20–30 seconds, followed by 50 seconds of data acquisition from the sample. An Excel-based software, ICPMSDataCal, was used to perform off-line selection and integration of background and analyzed signals, time-drift correction, and quantitative calibration for trace element analysis and U-Pb dating (Liu et al., 2008; Liu et al., 2010). Concordia diagrams and weighted mean calculations were conducted using Isoplot/Ex_ver3 (Ludwig, 2003).

*Note:The real in-situ U-Pb dating of zircon in thin-section can cite reference of Zong et al. (2010).*

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