1.11 金红石 LA-ICP-MS 微区原位 U-Pb 定年和微量元素分析

金红石 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。详细的仪器参数和分析流程见（Zhang et al., 2019）。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。两者在进入 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采用金红石标准 RMJG 和玻璃标准物质 NIST610 作外标分别进行同位素和微量元素分馏校正。每个时间分辨分析数据包括大约 20-30 s 空白信号和 50 s 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及 U-Pb 同位素比值和年龄计算）采用软件 Iolite4.0 完成(Paton et al. ,2011)。金红石样品的 Tera-wasserburg 图解绘制和 ^{207}Pb 校正年龄加权平均计算采用 Isoplot/Ex_ver3 (Ludwig, 2003) 完成。

1.11 In-situ U-Pb dating and trace element analysis of Rutile by LA-ICP-MS

U-Pb dating and trace element analysis of rutile 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 and the ICP-MS instrument and data reduction are the same as description by （Zhang et al., 2019）. 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. rutile RMJG and glass NIST610 were used as external standards for U-Pb dating and trace element calibration, respectively. Each analysis incorporated a background acquisition of approximately 20-30 s followed by 50 s of data acquisition from the sample. An software Iolite4.0(Paton et al., 2011) was used to perform off-line selection and integration of background and analyzed signals, time-drift correction and U-Pb dating. The Tera-wasserburg diagram of rutile samples and the ^{207}Pb corrected age weighted average were calculated using Isoplot/Ex_ Ver3 (Ludwig, 2003) completed.

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