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Short Communications (Research Advances)

LA-ICP-MS zircon U-Pb dating of dacite in the Sangthong Au mining area, Luang Prabang-Loei metallogenetic belt, SW Laos

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1. Objective

The Luang Prabang (Laos)–Loei (Thailand) metallogenetic belt, located along the northwestern margin of the Indochina Block (Fig. 1a) and endowed nearly 200 t of gold and more than 10^6 t of copper, is one of the most important gold-copper metallogenic belts in Indo-China Peninsula. It has undergone tectonic changes during the Early Paleozoic to Mesozoic Proto-Paleo Tethys tectonic evolution, recorded by the Luang Prabang tectonic belt, the Nan-Uttaradit suture, and the Dien Bien Phu-Loei suture. Previous geochronology studies revealed that the gold-copper deposits were mainly formed along with the subduction and closure of the Paleo-Tethys Ocean during the late Permian-middle Triassic (Khin Z et al., 2014; Guo LN et al., 2022). However, there are few reports on magmatic activities related to Proto-Tethys Oceanic evolution, thus the relationship between the tectonic-magmatic processes and potential mineralization during Early Paleozoic remain controversial. The belt was historically known for epithermal Au-Ag deposits in the southern part, porphyry-skarn Cu-Au deposits in the middle part, and orogenic Au deposit in the northern part (Khin Z et al., 2014; Guo LN et al., 2022). Recent exploration and deposit research reveal that there are epithermal gold deposits, represent by the Sangthong Au deposit, occurred in the middle part of the metallogenetic belt along the Loei magmatic arc. They are hosted by volcanic complex, and are spatially adjacent to intermediate-acid intrusions and porphyry-skarn mineralization. They are characterized by silicification, chloritization, and propylitization in the wallrock, and vein-type orebodies consist of quartz and a large amount of metal sulfides including pyrite, arsenopyrite, galena, sphalerite, and chalcopyrite. In this paper, zircon chronological studies are conducted on the newly discovered dacite in the Sangthong Au mining area to accurately determine the age of volcanic activity, with the aim of enriching the basic geological data and revealing regional magmatic-gold mineralization relationship.

2. Methods

The sample crushing, zircon separation, target fabrication, and cathodoluminescence were conducted at the Guangzhou Tuo Yan testing technology Co., LTD. LA-ICP-MS zircon U-Pb analysis was carried out at the Analytical Laboratory Beijing Research Institute of Uranium Geology. A Coherent GeolasPro 193 nm laser-ablation system was used conjunction with a Thermo Scientific high resolution inductively coupled plasma mass spectrometry (HR-ICP-MS). The spot diameter was 32 μm with a laser pulse rate of 6 Hz. The energy density was 7J/cm^2. Zircon 91500 standard was used as an external standard for U-Th-Pb isotopic ratios, and zircon Plešovice was used as the monitoring sample. Raw data were processed using the ICPMSDataCal program (Liu YS et al., 2010). Data reduction and concordia diagram was carried out using the Isoplot 3.0 program.

3. Results

The dacite is light grey to light green in color, porphyritic texture, massive structure (Fig. 1c). The phenocrysts are mainly composed of plagioclase (75%) and quartz (25%), with diameter in 1−3 mm (Fig. 1d). The cathodoluminescence images show that the zircon grains are euhedral to subhedral, columnar in shape, with obvious narrow concussion band, single particles 80 μm to 180 μm long and 50 μm to 100 μm wide (Fig. 2a). The results of LA-ICP-MS U-Pb dating analysis show that the Th content of the 25 zircon grains ranges from 34.9×10^{-6} to 636×10^{-6}, the U content is 93.8×

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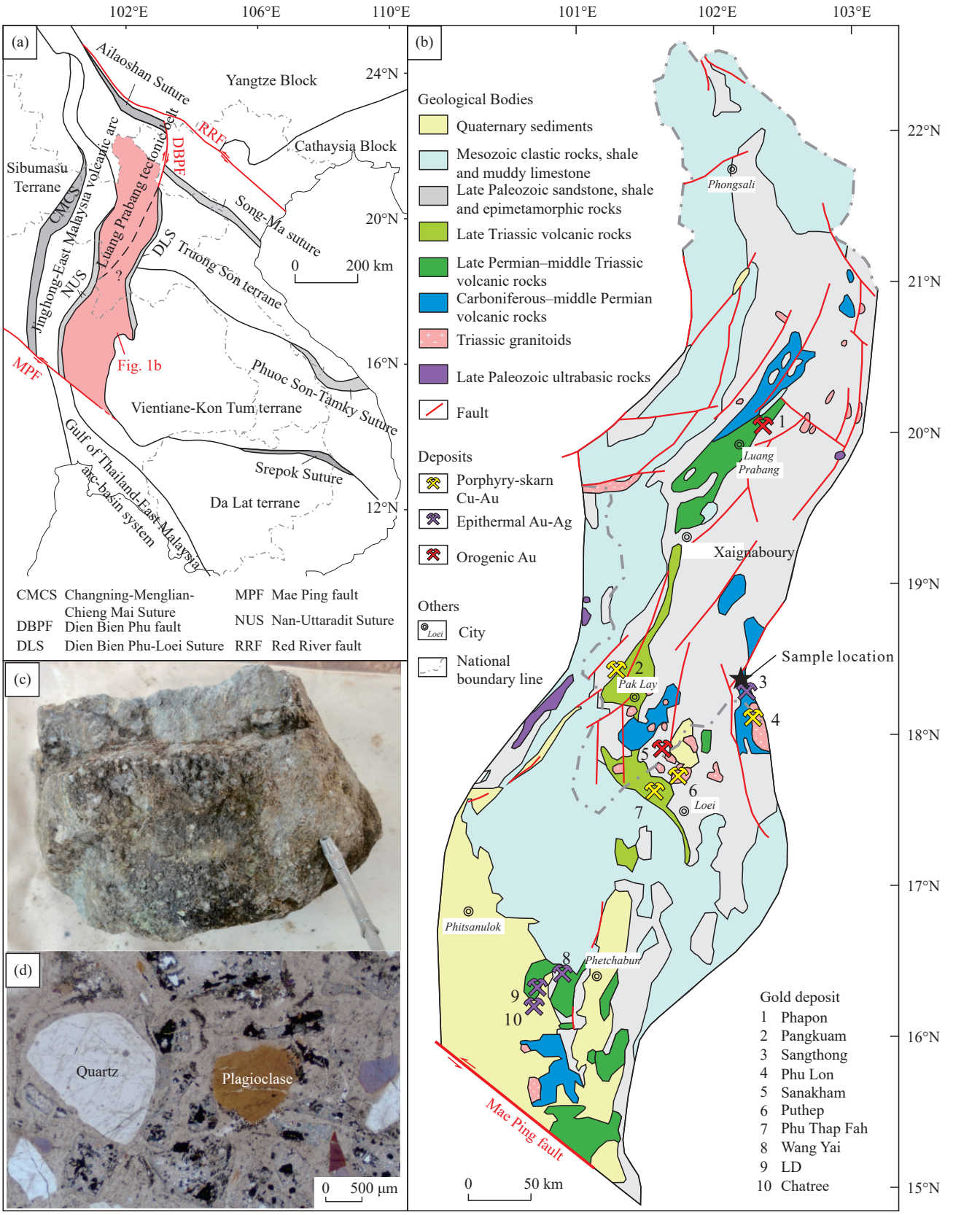

Fig. 1. Tectonic units of Laos and neighboring areas (a), simplified geological map of the Luang Prabang-Loei metallogenic belt (b), representative photograph of the dacite from Sangthong Au mining area (c, d).

10^{-6}–595×10^{-6}, and the Th/U ratios are from 0.37 to 1.07, indicating that they are magmatic in origin (Supplementary Table S1).

Except for one test point with concordance lower than 90%, the $^{206}Pb/^{238}U$ age of the rest 24 points ranges from 418 Ma to 434 Ma, with a weighted average age of 422.3±1.6 Ma (n=24, MSWD=0.53) (Fig. 2b, c).

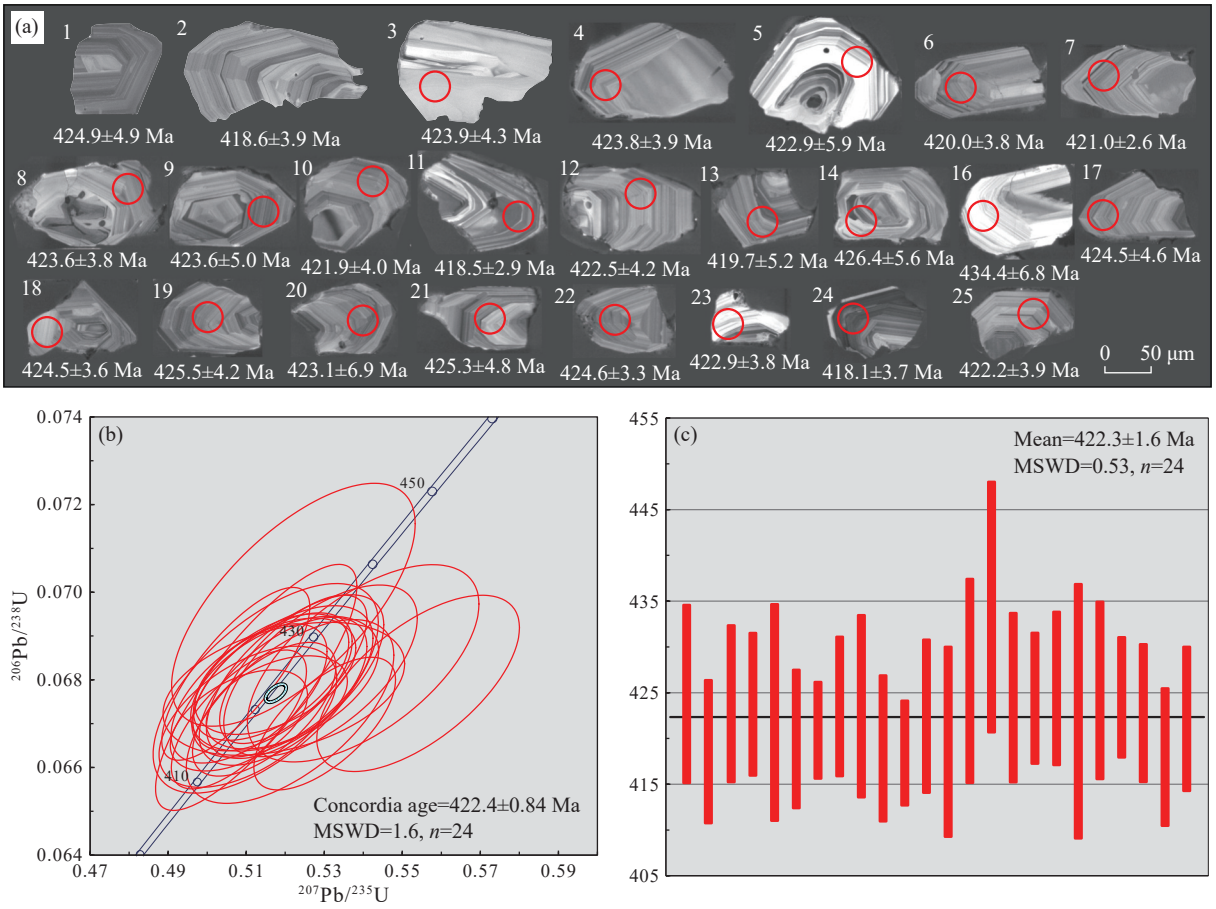

Fig. 2. Cathodoluminescence images of zircons in the dacite (a), and zircon U-Pb concordia and weighted average diagrams (b, c).

4. Conclusions

The dacite found in the Sangthong Au mining area has a zircon U-Pb weighted age of 422.3±1.6 Ma, which is consistent with the age of the volcaniclastic rocks in the Loei area in Thailand obtained by previous authors. Thus, it is believed that magmatic activity was widespread in the Loei magmatic arc in Middle-Late Silurian, which may indicate the existence of the Proto-Tethys Ocean in the along the northwestern margin of the Indochina Block. Besides, the dacite chronology was much earlier than the regional porphyry-skarn mineralization during Late Permian to Early Triassic, suggesting a potential for gold mineralization related to Proto-Tethys tectonic-magmatic evolution.

CRediT authorship contribution statement

Lin-nan Guo and Zhen-wen Liao conceived of the presented idea. Lin-nan Guo, Zhen-wen Liao, Bin Zhang, Yong-fei Yang, Si-wei Xu, and Hui-min Liang conducted the field work and collected the samples. Lin-nan Guo, Chun-mei Huang, and Xiang-ting Zeng analyzed the samples and drew all the figures. Lin-nan Guo and Chun-mei Huang verified the analytical methods. All authors discussed the results and contributed to the final manuscript.

Declaration of competing interest

The authors declare no conflicts of interest.

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Supplementary dataset

Supplementary data (Supplementary Table S1) to this article can be found online at doi: 10.31035/cg20240051.

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