Paleogene syn-collisional leucogranite with rutile exsolution in garnet, southern Tibet

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1. Summary

- Bulk-rock mineralogy and geochemistry of the Nyingchi leucogranite display S-type granite signatures, indicating of an anatexic origin.
- Complex texture, geochemistry and geochronology in zircon and garnet, indicating multiple stages of melting and cooling events. Rutile needles in garnet core suggest a high-T lower crustal source. Garnet zoning records rapid cooling (<25 kyr) from 900 °C to 700 °C for leucogranite magma migration and emplacement.
- Paleogene slab roll-back and breakoff would have resulted in enhanced asthenospheric corner flow and upwells, supplying a long-lived heat source for coeval crustal anatexis in the lower crust.

2. Geologic background and geochoronology

- Fig. 1. Geological map of southern Tibet and vicinity of the sampling location in Nyingchi.
- Fig. 2. Bulk rock composition of the leucogranite suggests S-type granite origin.
- Fig. 3. Zircon U-Pb dates suggest complex cooling history.

Fig. 1

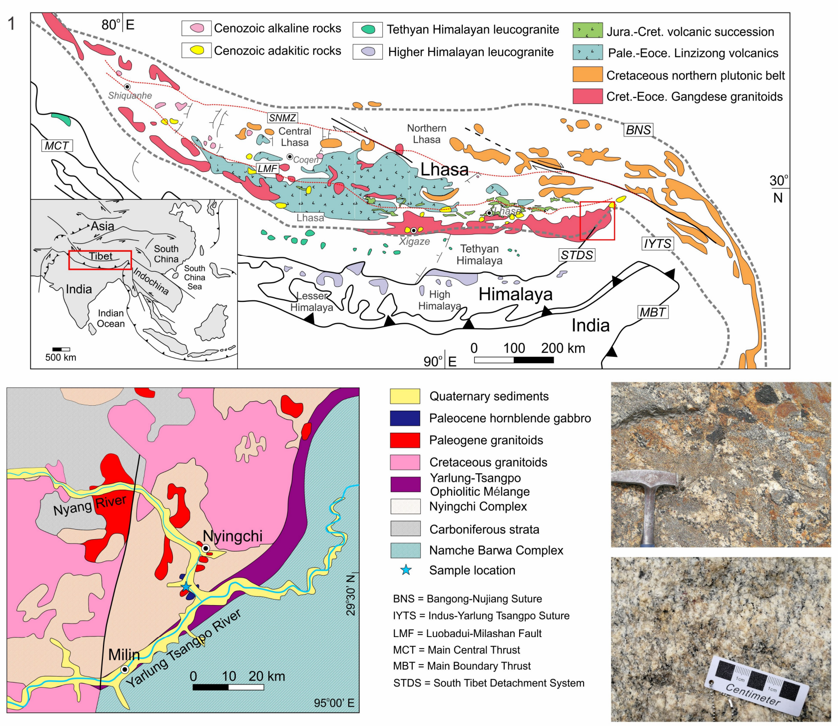


Fig. 2

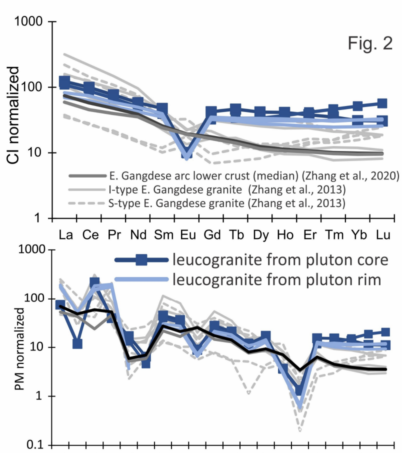
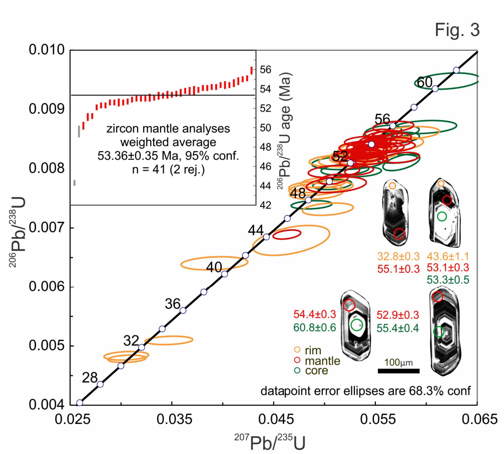


Fig. 3



3. Garnet geochemistry and multi-stage growth

- Garnet from the leucogranite display at lest three stages of growth based on their compositions (Fig. 4, 5). Garnet grainsfrom the core of the pluton is also featured with oriented needles of rutiles in the core, which is likely relics from the Gangdese lower crust material that underwent high temperature/pressure metamorphism but later brought up rapidly by leucogranite magma.

Fig. 4

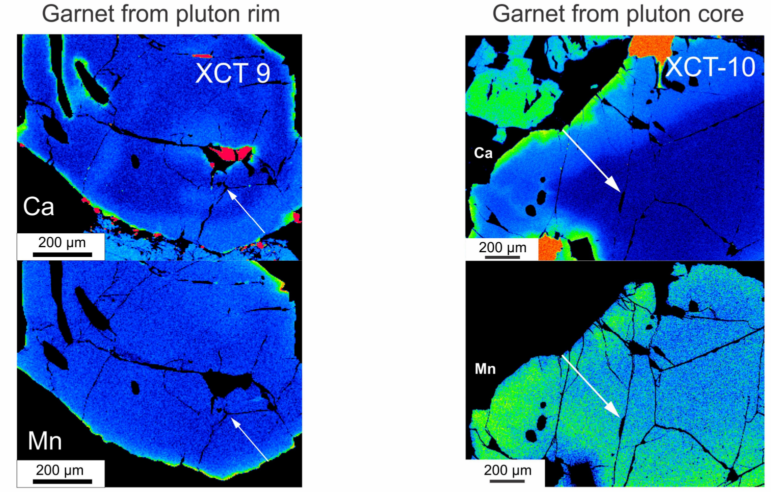
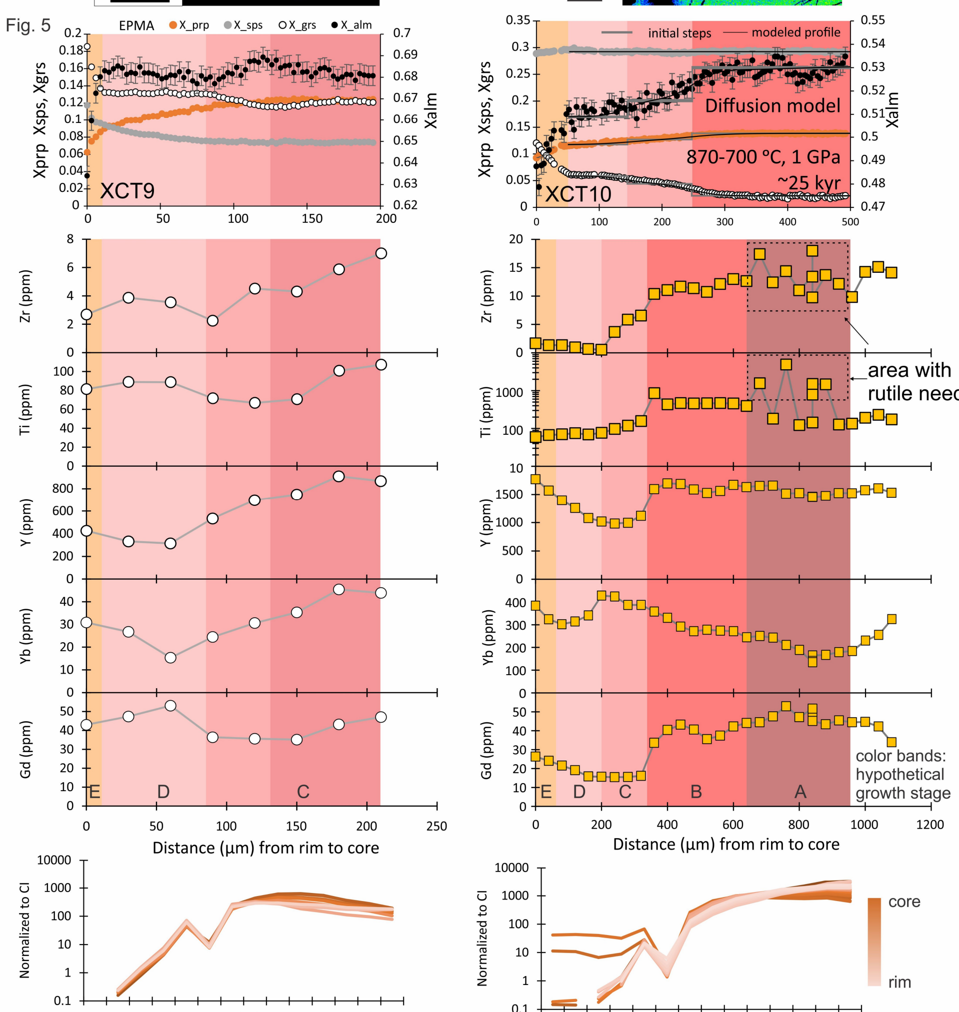


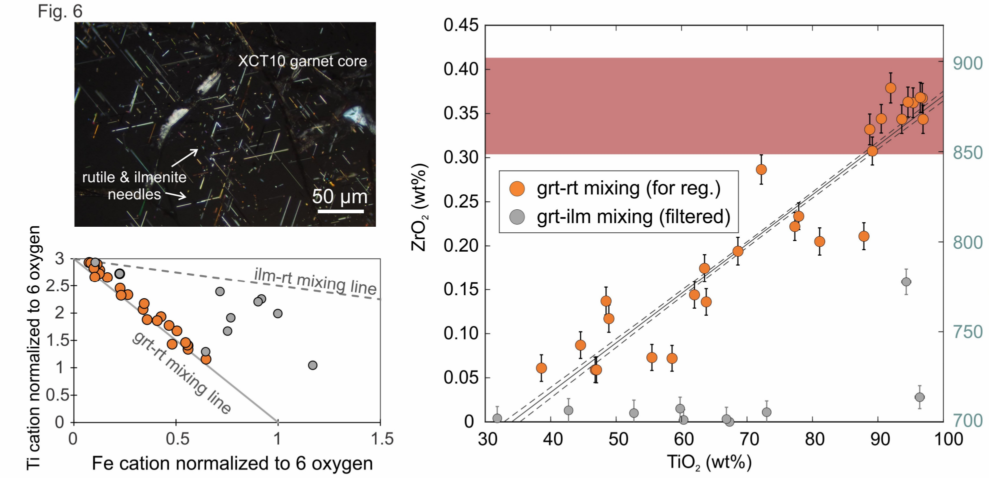
Fig. 5



4. (Ultra-)High-T lower crustal anatexis and rapid magma emplacement

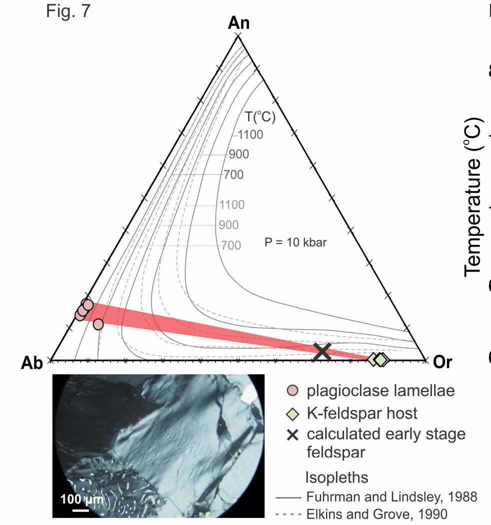
Zr-in-rutile thermometer: 880°C ± 25°C (Stage A)

Fig. 6



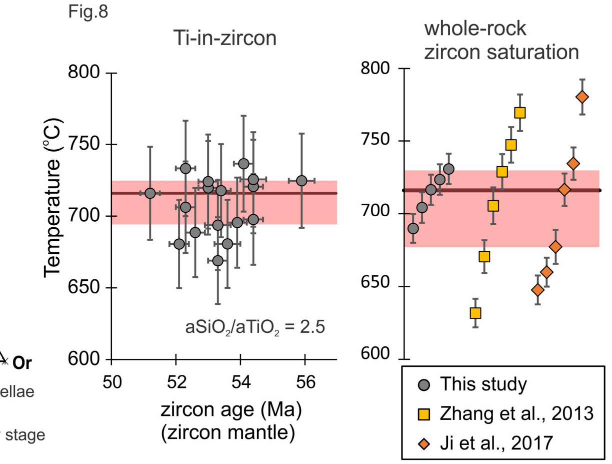
Ternary feldspar thermometer: ~850 °C (Stage B)

Fig. 7



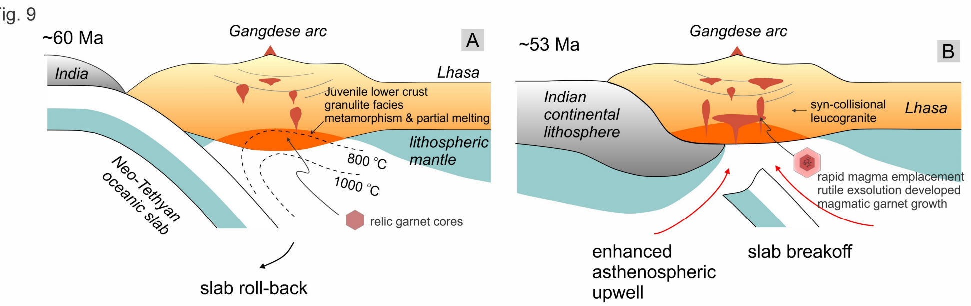
Zircon saturation and Ti-in-zircon thermometer: ~800-650 °C (Stage C-D)

Fig.8



5. Genetic model

Fig. 9



- The Paleogene slab roll-back and slab break-off before and during India-Asia collision would have resulted in enhanced asthenospheric corner flow and upwells, supplying a long-lived heat source for coeval crustal anatexis and metamorphism in southern Lhasa during the early phase of continental collision.