Multiphase TTG intrusions in the Paleoproterozoic greenstone belt of Suriname and their role in gold mineralization in the Rosebel gold district.

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Abstract

Four new U-Pb ages indicate two phases of TTG magmatism, namely around 2.19 - 2.16 Ga and around 2.12 - 2.11 Ga. The two phases of TTG magmatism are separated by an erosional event.

Introduction

The Rosebel gold district in the Paleoproterozoic greenstone belt of the Guiana Shield is a major orogenic gold district (Fig. 1), formed during the Trans-Amazonian Orogeny between 2.26 and 1.95 Ga (De Roever et al., 2015).

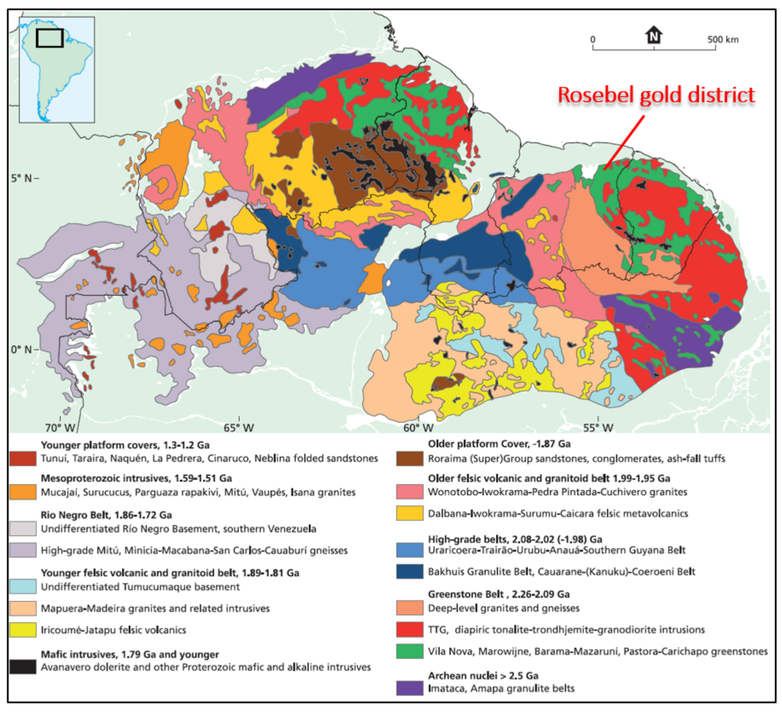

Fig. 1: Simplified geological map of the Guiana Shield (Kroonenberg et al., 2016).

Problem Statement

A large granitic pluton known as the Brincks intrusion is present at the southern boundary of the Rosebel Mining Concession. Several gold deposits, and further prospects, are located around and proximal to the Brincks intrusion, although the emplacement and its relationship with the neighboring gold deposits is not fully understood.

Purpose

This body of research investigates the role of the Brinck intrusion in the petrogeny of the Rosebel basin, whether it may have intruded as a single pulse (phase) or during multiple pulses (polyphase), and the genetic relationship between the intrusion and the neighboring gold deposits.

Methods

Accurate data on the absolute timing of crystallization of rock types defined in the Rosebel area were crucial in order to reconstruct the stratigraphic and deformational relationships and to elucidate the evolutionary history of mineralization around the granites.
Zircon U-Pb ages of the rocks were obtained using the LA-ICP-MS technique. Detailed internal textures of zircons have been analysed using Cathodoluminesence (CL) imaging methods (Fig. 2).

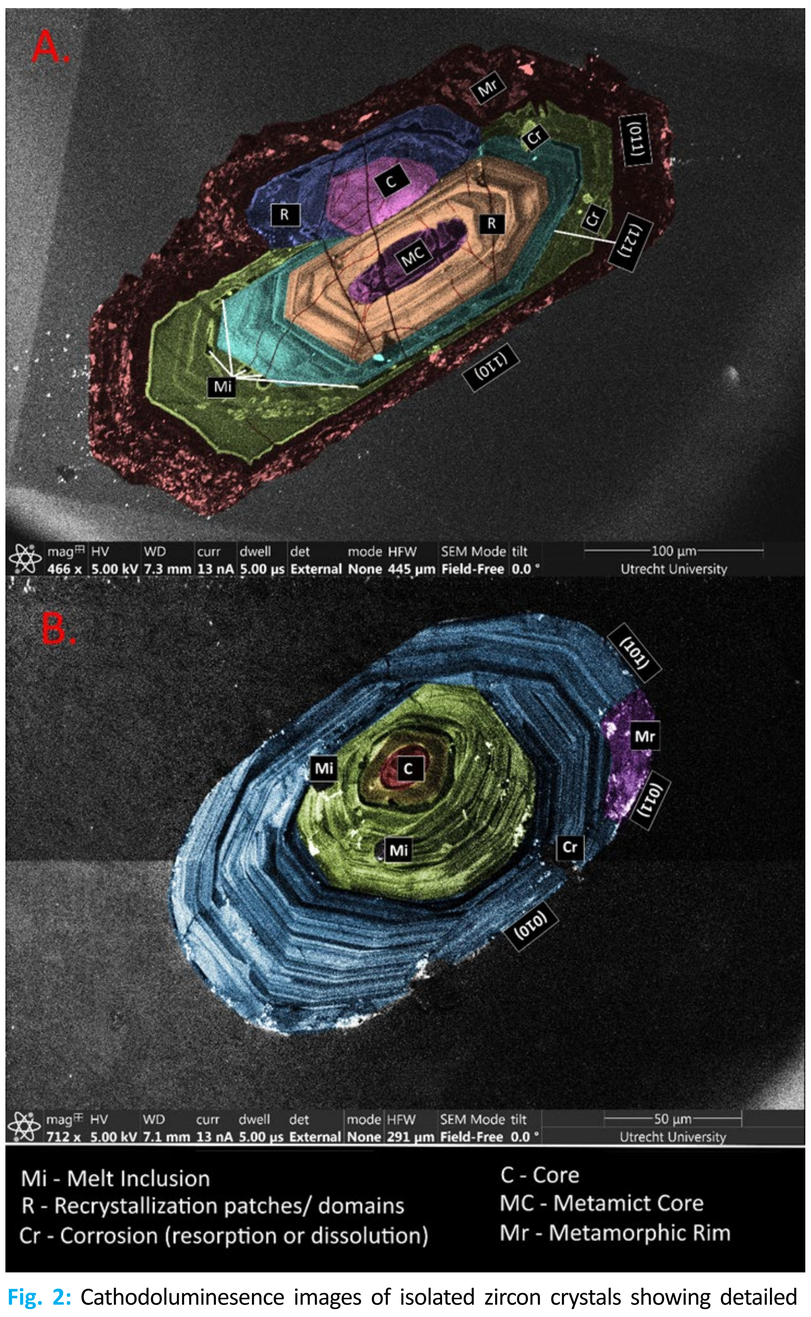

Fig. 2: Cathodoluminesence images of isolated zircon crystals showing detailed zircon patterns and different domains. (A) Zircon from the Atjoni Road granite with a pronounced outer-rim due to changing T-P conditions. (B) Zircon from the Royal Hill rhyolite with well-developed oscillatory zoning and in which metamorphic remnants are minor features (Hoogendoorn, 2017).

Results of dating

1. Granite (Atjoni Road)

The calculated 207Pb/206Pb ages tend to cluster around 2,186 Ma (Fig. 3). The rock contain inherited older Hadean-Archean zircon ages, which demonstrates the existence of an underlying crustal block representing the oldest crustal component of the Guiana Shield. An age of 4.25 Ma records the signature of Early Earth.

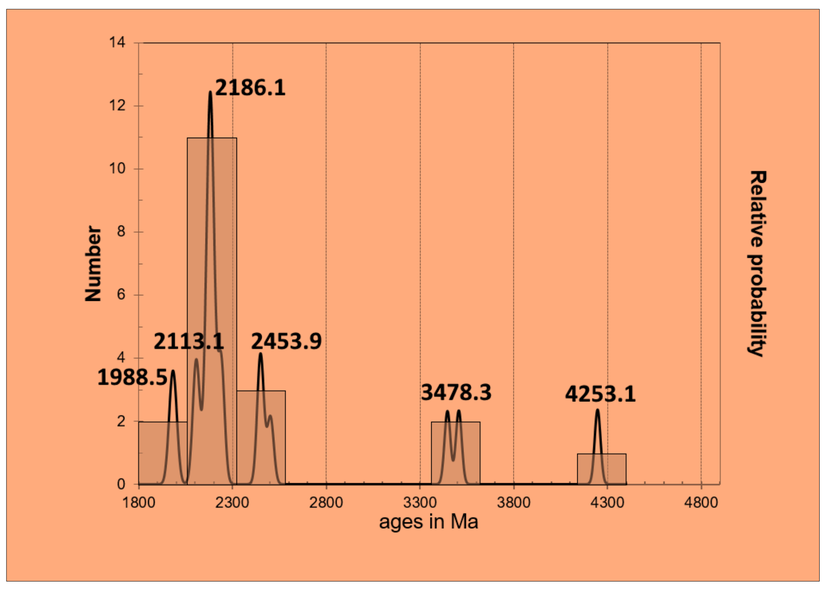

Figure 3: Probability frequency diagram of measured zircons of the granite sample from the Atjoni Road (Hoogendoorn, 2017).

2. Rhyolite (north of Royal Hill pit)

The 207Pb/206Pb values tend to cluster around 2,121 Ma. One of the zircons shows a significantly older age of 2,642 Ma which could be a recycled zircon from an Archean nucleus that has been reworked and mixed with a Paleoproterozoic source.

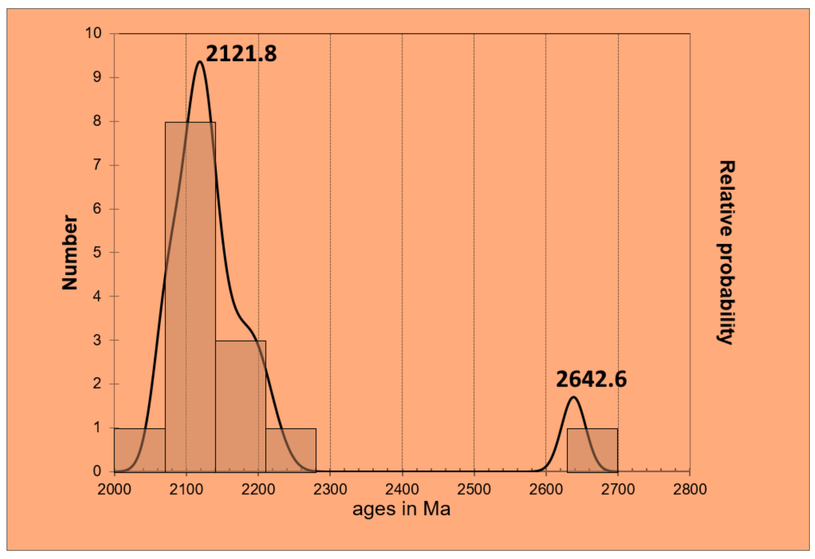

Figure 4: Probability frequency diagram of measured zircons of the rhyolite sample (Hoogendoorn, 2017).

3. Trondhjemite (north of Brinck intrusion)

The calculated 207Pb/206Pb ages tend to cluster around 2,113 Ma (Fig. 5). One of the zircons shows a significantly older age of 2,998 Ma which could be a recycled zircon from an older source rock.

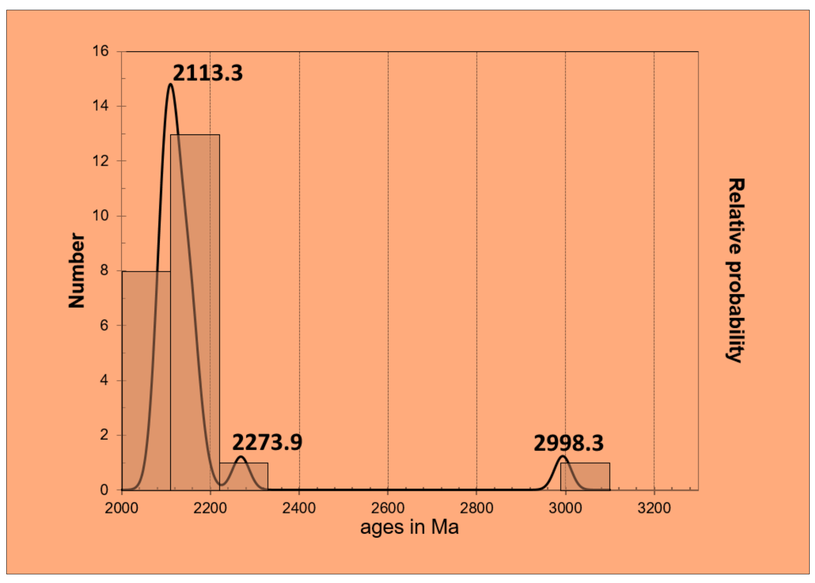

Figure 5: Probability frequency diagram of measured zircons of the trondhjemite sample (Hoogendoorn, 2017).

4. Granite (Koemboe area)

The 207Pb/206Pb values tend to cluster around 2,109 Ma (Fig. 6). Some older core exist which cluster around 2,221 Ma and in a specific case around 2,328 Ma.

Figure 6: Probability frequency diagram of measured zircons of the granite sample from the Koemboe area (Hoogendoorn, 2017).

Conclusions

- Based on the age dating results two phases of TTG magmatism at ca. 2.19 - 2.16 Ga and 2.12 - 2.11 Ga with a lack of geochronological values in the 2.16 - 2.12 Ga range can be distinguished (Fig. 7, 8).
- The two phases of TTG magmatism are separated by an erosional event as evidenced by a basal conglomerate containing granite clasts, which also contains the 2.12 Ga rhyolite layer from Royal Hill higher in the sequence.

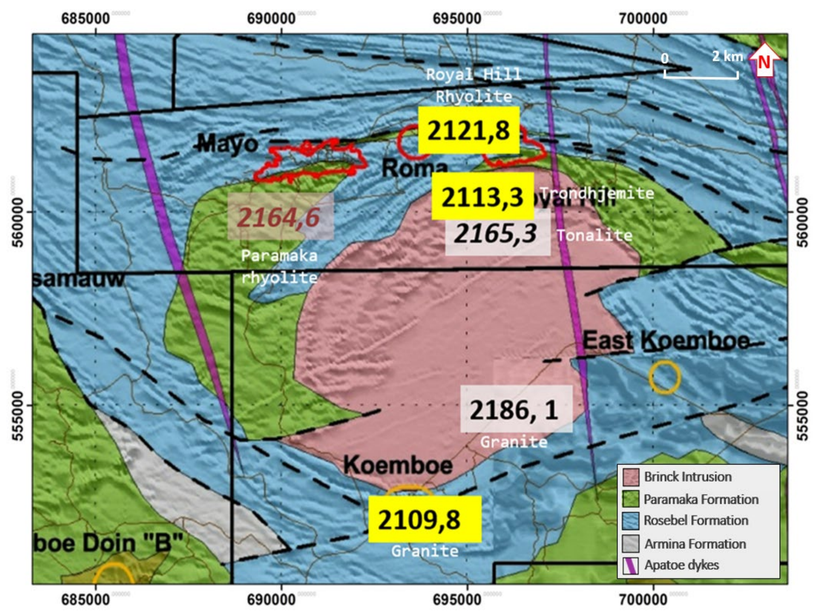

Figure 7: Age dating results of TTG intrusives in the Rosebel area. In grey dates which correlates with the first phase of TTG magmatism between 2.19 – 2.16 Ga and in yellow dates which correlates with the second stage of TTG magmatism between 2.12 – 2.11 Ga. In italic an age obtained by Daoust (2016) which correlates with the first phase of TTG magmatism.

- Limited published geochronology for the Guiana Shield orogenic gold deposits indicates mineralization during two distinct episodes between 2.08 - 2.02 Ga and 2.0 - 1.95 Ga which is broadly coëval with post-peak metamorphism at shallow levels and post-peak metamorphism at deeper crustal levels (Fig. 8).
- The two phases of TTG magmatism predate the two episodes of gold mineralization and a direct bearing on the gold mineralization is unlikely.

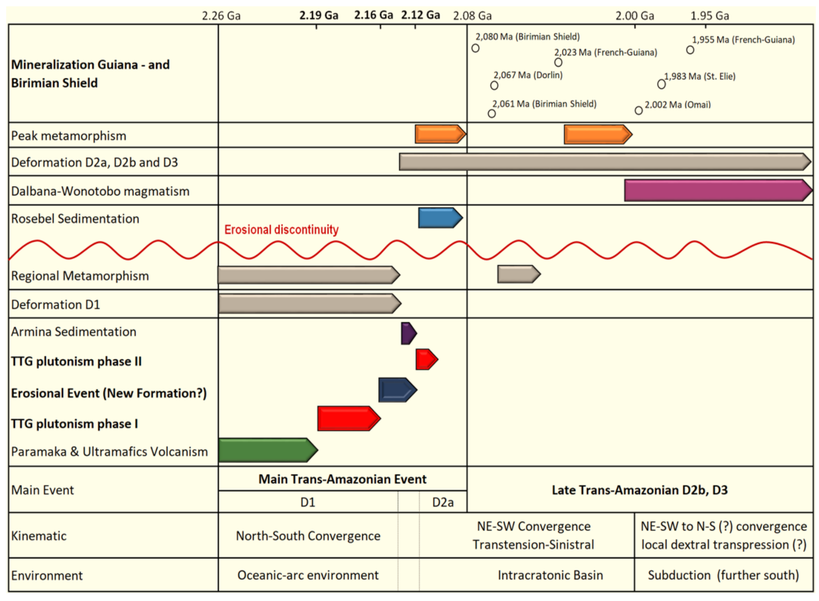

Figure 8: New dates for TTG magmatism at Rosebel with respect to the timing of major geotectonic events and gold mineralization in the Guiana Shield.

Recommendations

- Further dating:
  - to better assess whether the two-step TTG accretion is valid or whether we are dealing with a relatively continuous TTG process from 2.19 – 2.08 Ga.
  - to better assess the implications of Archean material both on the source of gold and the development of the Guiana Shield in general.
- Dating of the gold mineralization:
  - further dating of the gold mineralization throughout the Guiana Shield including the Rosebel Gold district is recommended to constrain the two likely phases of gold deposition through time in relation to magmatic and deformation processes.

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