Evolution and Thermo-Tectonic Development of The Basement complex, West-central Sinai, Egypt: Constraints from Uranium-Lead Dating and Apatite Fission Track Low-Temperature Thermochronology

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Abstract

This study focuses on relatively small area in Sinai to reconstruct detailed thermal and tectonic histories of representative rock units for Sinai. Sixteen samples were collected all over the area of study. Zircon U-Pb dating technique was applied on thirteen samples. Three intense magmatic activities control the scheme of the basement classification; Early-orogenic metamorphic magmatic activity occurred in a time span extended from 861 to 807 Ma, Syn-orogenic grey and red granites occurred in a time span extended from 748 to 739 Ma, and Late-orogenic magmatic activity in time span extended from 613 to 535 Ma. Each of Syn-orogenic and Late-orogenic activities were represented as series of granitic intrusions in which red granites form instead of grey granites along with increasing potash and changing into extensional environment conditions. Pre-Pan-African older zircon grains (2273, 1755, 1241, 1003 and 989 Ma) are possibly inherited from the island-arc nucleus. Magmatic intrusions event in the Ordovician-Devonian time must be intense based on number of zircon grains of this age (Fig.1).

Apatite fission track method was applied on fourteen samples with operating 156 analyses on 125 apatite grains to measure U, Th and Pb isotopic concentrations and ratios in addition to counting surface tracks, measuring the HCTLs and Dpar in every analyzed grain. Thermal histories were reconstructed for all treated samples indicate four exhumation events occurred in Precambrian, Devonian-Carboniferous, Jurassic-Cretaceous and Oligocene-Miocene as response to four tectonic events caused by subduction-related erosion which was finished by the Cambrian time, collision between Gondwana and Laurasia (Hercynian tectonic event), break apart of Gondwana and/or opening of Mid-Atlantic and the Gulf of Suez formation, respectively. Interestingly these tectonic events affected three regions which are separated spatially represent differential movement most probably along fault-bounded blocks or anticline syncline relationship (Fig. 2). The Gulf of Suez is a passive type rift which formation was accompanied by low to moderate thermal overprinting on the rift flanks. These flanks were uplifted from depths of 1-1.5 km with cooling rates of 8-12 ºC/Ma and uplifting rates of 0.2-0.3 km/Ma.

Reference

El-Bialy, M.Z., 2004. Petrologic, geochemical and pertogenetic characterization of the old granites of Sinai, Egypt. Unpublished Ph.D. Thesis, Suez Canal University, Ismailia, Egypt, 230p.

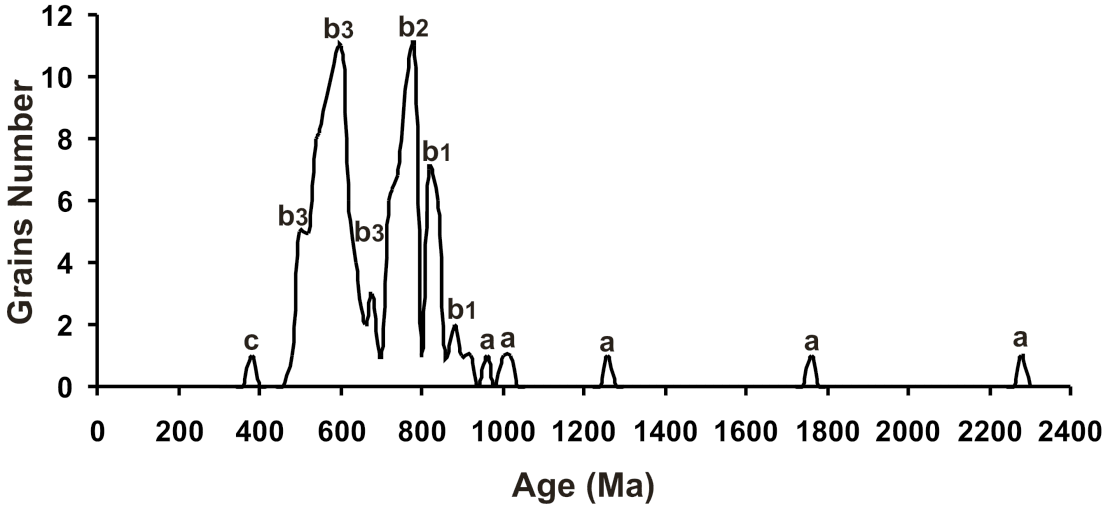

Fig. 1. Age density histogram for zircons 238U/206Pb ages for all concordant grains;a) Pre-Pan-African age grains, b) Pan-African age grains where b1 Early orogenic suite, b2 Syn orogenic suite and b3 Late orogenic suite, c) Post-Pan-African age grains.

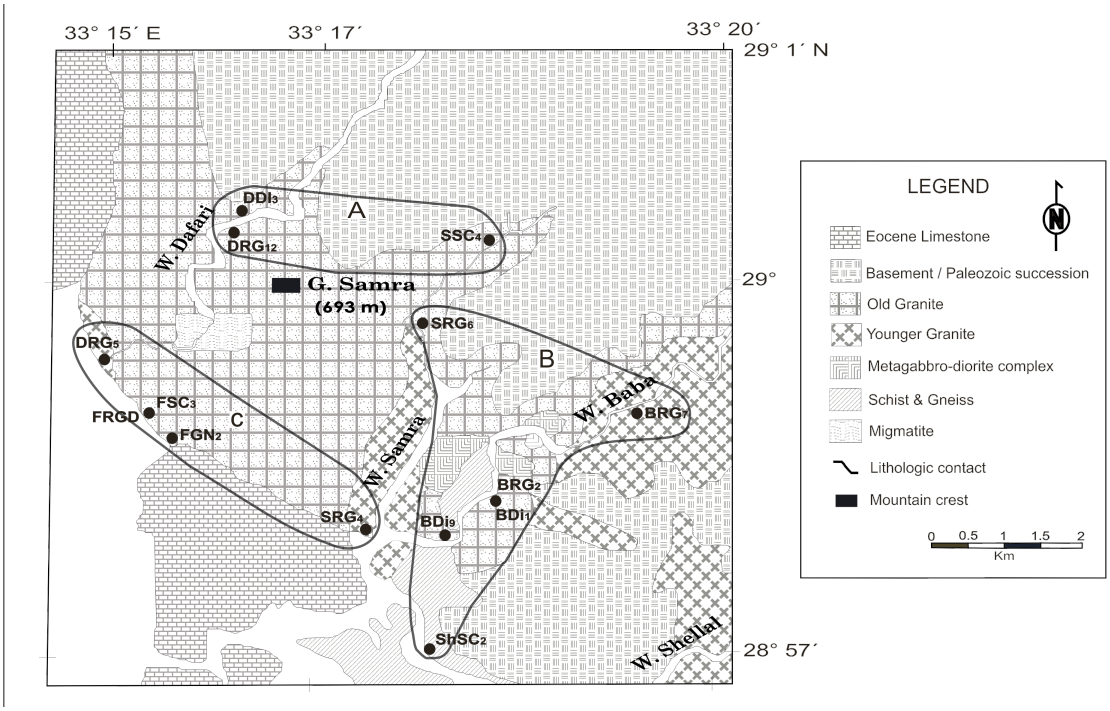

Fig. 2. Simplified Geologic Map for Gebel Samra area (modified after El-Bialy, 2004) representing the locations of the studied samples and the three apatite FT age groups zones; A the Precambrian-Ordovician group, B the Devonian-Carboniferous group, C the Jurassic-Cretaceous group, see the text and table 4 for more details.