フィッション・トラック　ニュースレター　第22号　31-32　2009年

Apatite Fission-Track and Zircon U-Pb LA-ICP-MS Dating of Abu Zenima area West-Central Sinai, Egypt

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Abu Zenima area occupy the north-western corner of the basement complex of Sinai which mainly formed during the Neoproterozoic and early Phanerozoic during the Pan-African orogeny, located directly on the eastern border of the Oligo-Miocene Gulf of Suez. The studied area (Fig. 1) consists from (1) metasediments and metavolcanics formed in the earliest stage of the Pan-African orogeny, (2) older grey granites (mainly diorite and trondhjemite) formed during compressional environment during the next stage of the Pan-African orogeny, (3) limited extent of younger pink granites intruding in older granites formed at the last stage of the Pan-African orogeny which may be interpreted as an extensional collapse stage (e.g. Dewey, 1988; Platt and England, 1993), (4) and successive dike sets of bimodal chemistry (rhyolitic and basaltic).

The U-Pb system is resistant to thermal overprinting and is thus unaffected by later thermal events when suitable minerals such as zircon are analyzed (>900 °C). Therefore, U–Pb analysis of zircon, is generally the best way to date the crystallization age of old igneous rocks. While, fission track (FT) dating observe a damage zone formed by the spontaneous fission of heavy elements such as uranium, and useful to reconstruct the late thermal event of the region.

The laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) is a rapidly developing method that is taking its place among other in situ trace element and isotope measurement methods such as SIMS (Secondary Ion Mass Spectrometry) or SHRIMP (Super High Resolution Ion Micro Probe). The advantages are (1) in situ dating of the accessory phases, (2) spatial resolution of several spot analyses within a single grain of an accessory mineral that is often less than 200 - 300 microns in size, (3) small or zero Pb blank introduced to the sample during the analysis, and (4) quick and simple sample preparation procedures. These advantages in the technology of LA-ICP-MS make it a rapid, precise and accurate method for FT and U–Pb dates obtained simultaneously. The U and Th concentrations as well as concentrations of Pb isotopes were measured by the LA-ICP-MS unit at Kanazawa University.

Eighteen samples were collected to represent the main rock units exist in the studied area; eight were treated with U-Pb technique in order to investigate their crystallization ages and ten with FT technique to calculate their cooling ages.

Seven igneous and metamorphic samples dated by U-Pb technique range from diorite (581±15 Ma, 565±28 Ma), red granite (592±11 Ma, 580±10 Ma), gneissose granite (595±12 Ma) to rhyolitic and granitic dykes (566±9 Ma, 563±9 Ma). These data indicate the coeval occurrence of both alkaline and calc-alkaline granitoids in the time span extended from 595 Ma to 565 Ma followed directly by dike injection stage. One detrital sample collected from the sandy Carboniferous Ataqa Formation represented four provenance sources; Pre-Pan-African suite (1831±31 Ma, 1009±46 Ma), older granitoids suite (8 grains ranges from 736±33 Ma to 616±28 Ma), younger granitoids suite (7 grains ranges from 607±28 Ma to 566±26 Ma), post cratonization suite (501±23 Ma, 477±42 Ma, 460±21 Ma, 312±14 Ma). Indicate the pre-Pan-African probability, these data indicate the presence of older granite suite in Sinai which may be metamorphosed, eroded or remelted, and probable magmatic event in the Devonian-Carboniferous time accompanied by the Hercynian tectonic event. FT apatite data were obtained from ten igneous and metamorphic samples range in composition between red granite, diorite, rhyolitic dikes, granitoid dikes, schist and gneiss. These samples show two age groups, Carboniferous and Cretaceous, separated

spatially (Fig. 1). Considering the simultaneous crystallization age of the main rock units in the studied area and the small distance between distribution of the two age groups, different thermo- tectonic history between the two age zones indicates the preferential uplift in the studied area which had occurred during the Carboniferous Hercynian tectonic event.

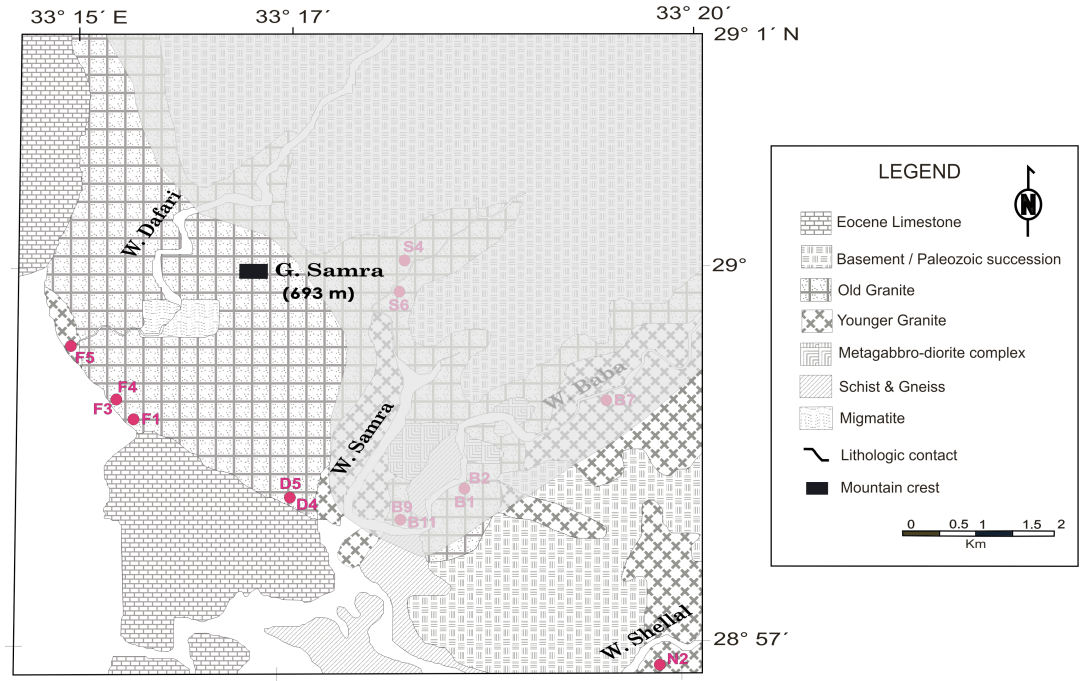

Fig. 1. Geologic Map of the Study Area (modified after El Bially 2004) identifying the Carboniferous (gray zone) and Cretaceous FT age groups.