[PS]Petrochemistry of the Lower Cambrian Araba Formation, Taba Area, East Sinai, Egypt*

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Search and Discovery Article #50655 (2012)**
Posted July 23, 2012

*Adapted from poster presentation at AAPG Annual Convention and Exhibition, Long Beach, California, April 22-25, 2012

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Abstract

Petrographical and geochemical analyses of the siliciclastic succession of the Lower Cambrian Araba Formation, Taba area, East Sinai, Egypt have been carried out to infer their provenance, tectonic setting and paleoweathering conditions. The succession (~ 70 m thick) consists of basal conglomerate, very fine-grained to pebbly sandstone with carbonate, siltstone and mudstone intercalations. It rests nonconformably over the Precambrian basement complex and underlies the Upper Cambrian Naqus Formation. The Araba Formation comprises six facies assemblages of remarkable textural and compositional variations. They are braided fluvial, sheet flood-dominated alluvial fan, flood plain, intertidal, beachface/subtidal and offshore. The sandstones are essentially subarkose, with subordinate amounts of sublitharenite and litharenite. Monocrystalline quartz is the most abundant mineral phase compared with polycrystalline grains and followed by K-feldspar and rock fragments, respectively. Lithic grains include acidic granites, metavolcanics and rarely chert fragments. Accessories include micas, zircon, tourmaline, rutile, hornblende, apatite and Fe-Ti oxides. Cementing materials include clay minerals, hematitic Fe-oxide, apatite, non-ferron calcite and dolomite, quartz and feldspar overgrowths, as well as barite and halite. XRD analysis reveals that smectite, I/S mixed layer, illite and minor kaolinite are the principal clay minerals. Porosity is represented by intergranular, intragranular, fracture, moldic and micro-intergranular variety. Geochemically, the Araba sandstones are characterized by higher values of SiO_2, Al_2O_3, K_2O, Ba, Rb, Sr, Zr, higher ratios of Al_2O_3/TiO_2, $K_2O/Na_2O>>1$, $Al_2O3/(CaO+Na_2O)$ and Th/Co, and lower values of Fe_2O_3*+MgO, TiO_2, Ni, Cr and V. The data reveals that the source area was subjected to uplift of low to moderate relief continental block that eroded under the influence of semi-humid to semi-arid climatic regimes and indicated the deposition in a passive continental margin setting. The detritus are mainly derived from the nearby Precambrian granites and acidic metavolcanics, together with the surrounding metamorphic rocks and cherts. The moderate values of paleoweathering Indices (Chemical and Plagioclase Index of Alterations; CIA and PIA, respectively) suggest that these sediments were primarily exposed to mild chemical weathering at the source area and later subjected to slight diagenetic modifications.

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OBJECTIVES

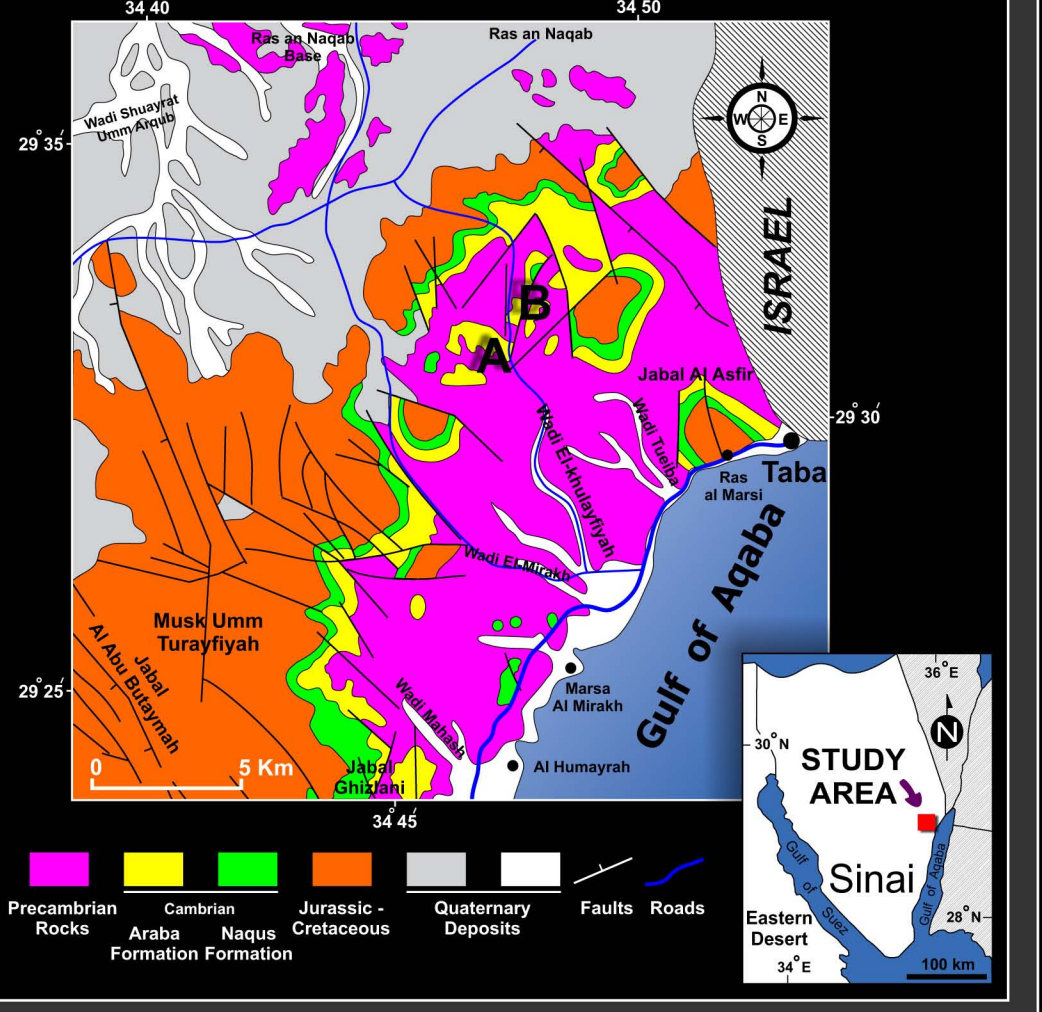
Addressing the petrographical characteristics, most diagenetic modifications and generalized mineral paragenesis, possible source, and paleoweathering effects on the Cambrian Araba sandstones.

TECHNIQUES

Field work, facies analysis and laboratory studies including; petrographic examination and modal analysis; X-ray diffraction analysis (XRD); Scanning electron microscopy (SEM); Electron microprobe analysis (EMPA); Back-scattered electron imaging (BSE); and X-ray fluorescence (XRF) of major and trace elements.

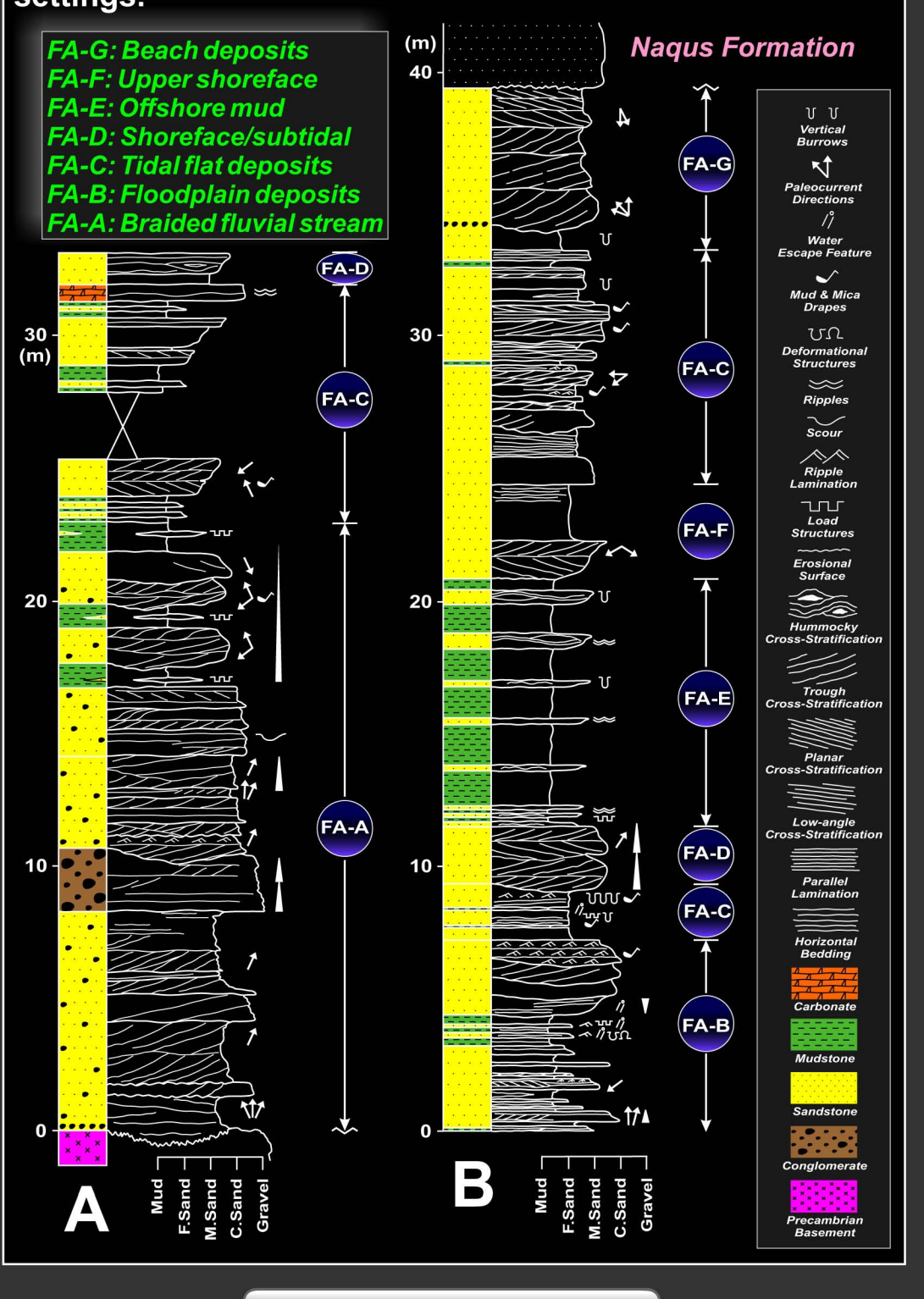
STUDY AREA

The study area lies on the Eastern part of Sinai Peninsula, to the west of Taba City and the Gulf of Aqaba. The siliciclastic succession of the Araba Formation is non-conformably overlies the Precambrian rocks and underlies the Naqus Formation. The latter is unconformably succeeded by sedimentary strata ranging in age from the Jurassic to the late Cretaceous.



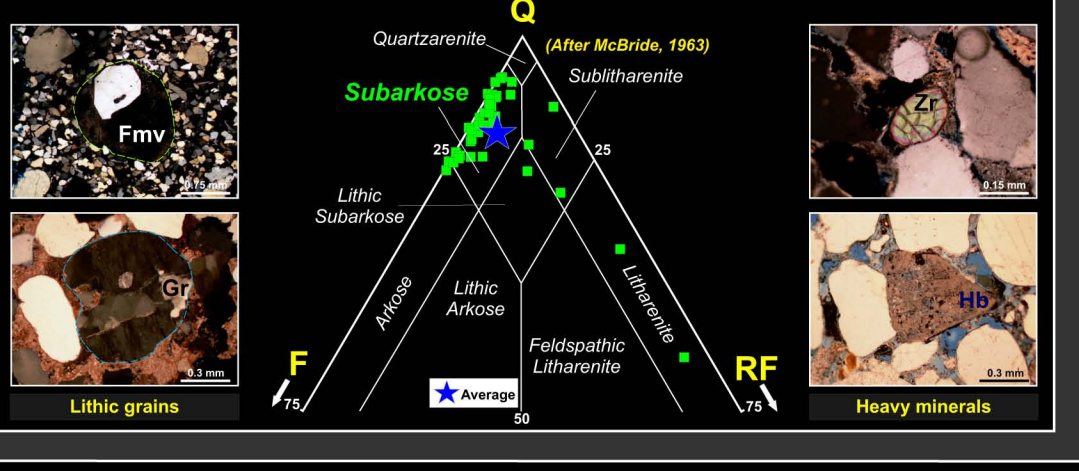
FACIES ANALYSIS

The Araba Formation consists mainly of very fine- to very coarse-grained sandstone with mudstone intercalations. Conglomerate and carbonate interbeds represent 5% of the succession. Sedimentary structures include; planar and trough cross-stratifications, tide-generated and deformational structures. Simple vertical burrows are the only observed trace fossils. The Araba Formation is subdivided into 7 facies assemblages (FA-A to FA-G) ranging from fluvial to transitional and to shallow-marine settings.



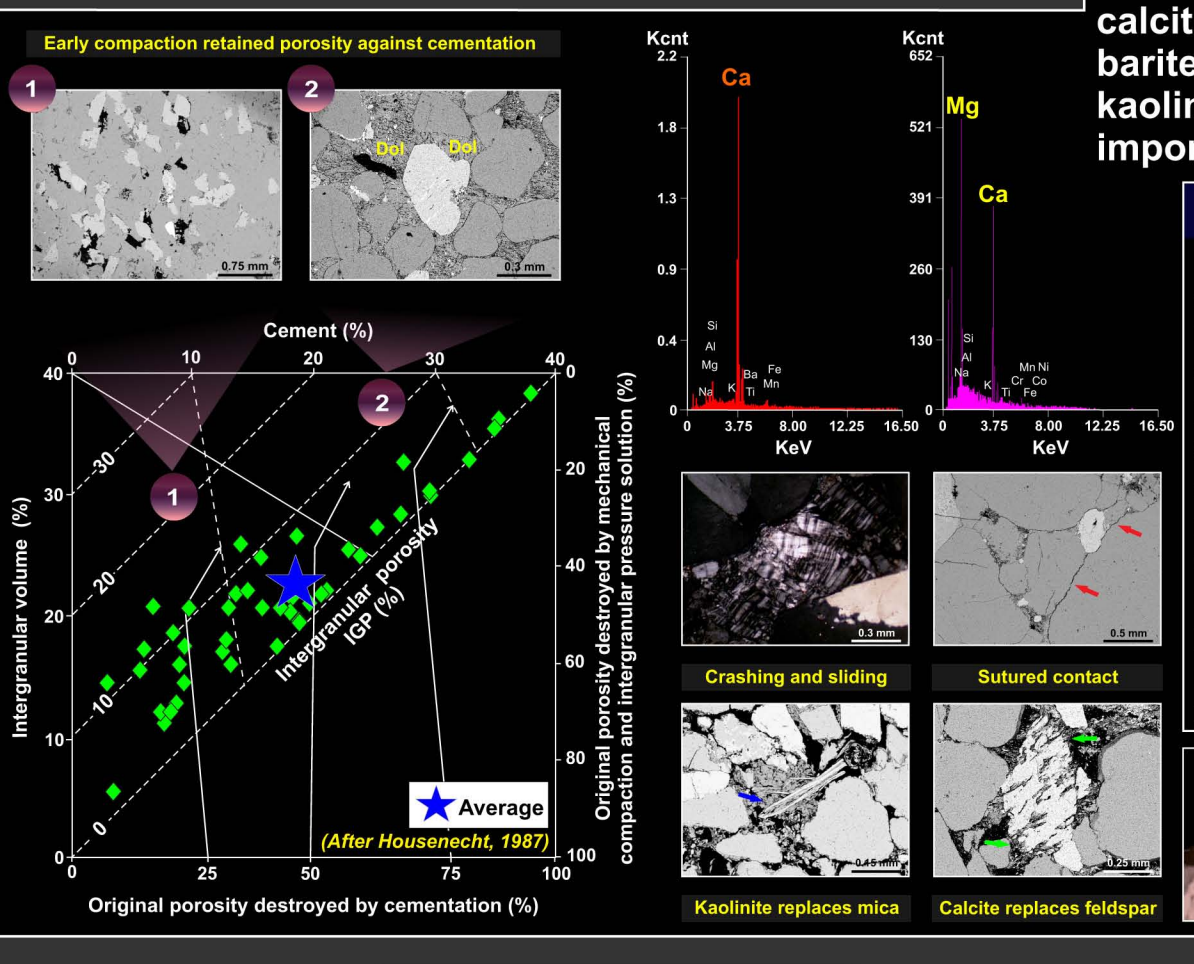
PETROGRAPHY

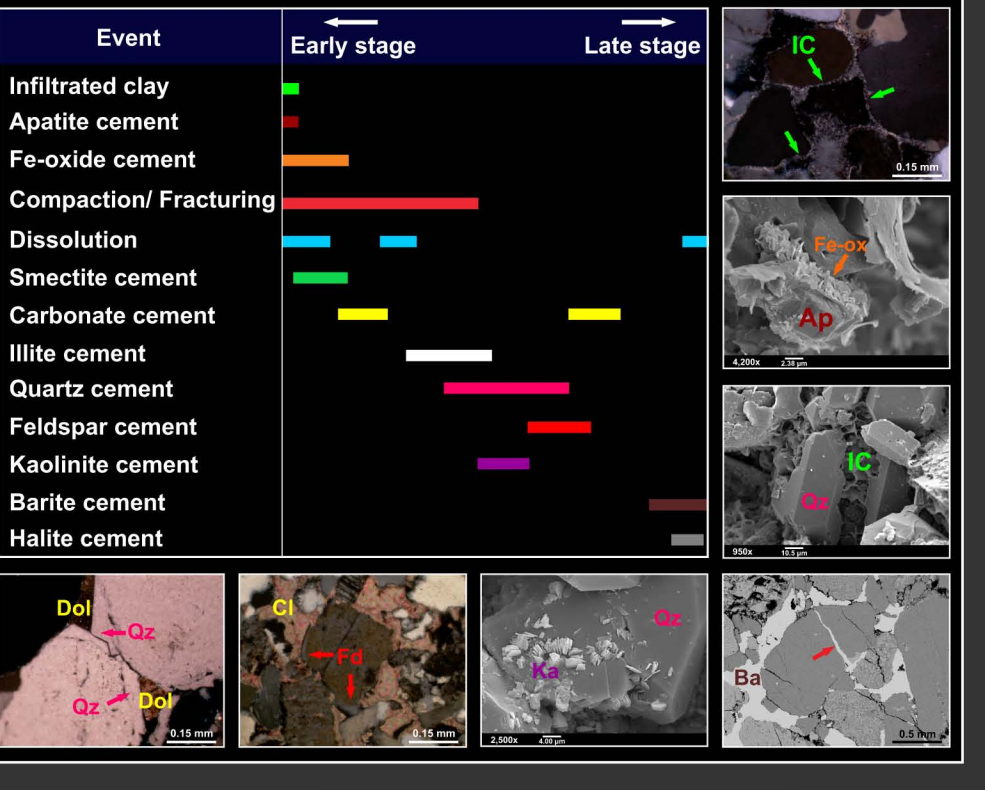
The Araba sandstone is mainly classified as subarkoses. Feldspars are dominated by K-variety. Felsic meta-volcanics and granites are the most lithic grains. Accessories include biotite, muscovite, zircon, tourmaline, hornblende and apatite. Visible porosity can be categorized as; intergranular, intragranular, fracture and moldic types.



DIAGENESIS

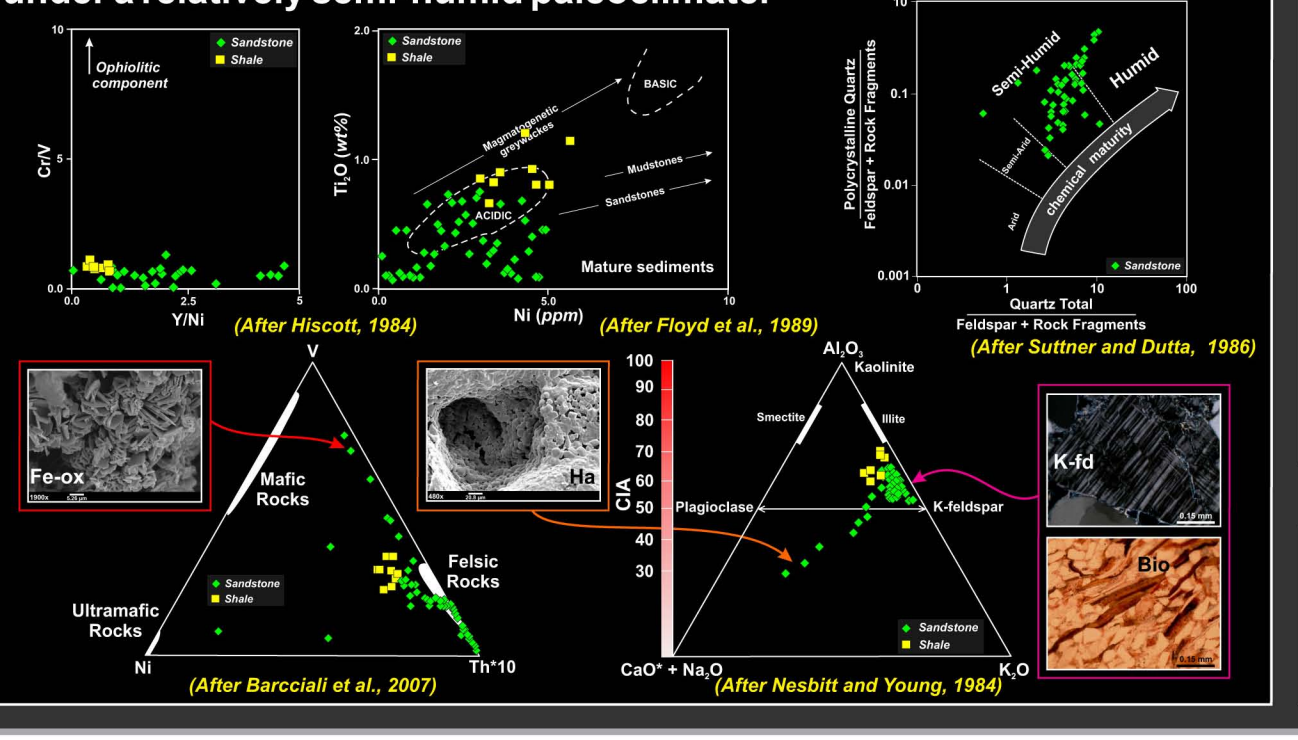
Diagenetic modifications include; compaction, infiltration of clay, cementation, dissolution and replacement. Cementing materials are; clay minerals, hematite, apatite, calcite and dolomite, quartz and feldspar overgrowths, barite and halite. Smectite, I/S mixed layer, illite and minor kaolinite are the principal clay minerals. Compaction more important than cementation in porosity reduction.





GEOCHEMISTRY

The Araba sandstones are characterized by higher values of SiO_2, Al_2O_3, K_2O, Ba, Rb, Sr, Zr, higher ratios of Al_2O_3/TiO_2, $K_2O/Na_2O>>1$, $Al_2O_3/(CaO+Na_2O)$ and Th/Co, and lower values of Fe_2O_3+MgO, TiO_2, Ni, Cr and V suggesting derivation from the nearby Precambrian granites and felsic metavolcanics and indicating the deposition in a passive continental margin setting. The moderate CIA and PIA values (av. 54 and 65 %, respectively) point to mild chemical weathering at the source area under a relatively semi-humid paleoclimate.



CONCLUSIONS

1. *Seven facies associations are identified, these are; braided fluvial, floodplain, tidal flat, shoreface/subtidal, offshore, upper shoreface and beach deposits.*
2. *The Araba Formation is mainly subarkoses. It was derived from acidic parent rocks such as metavolcanics and granites.*
3. *Most of depositional porosity was reduced by early-formed compaction and slightly by cementation.*
4. *The moderate values of paleoweathering indices suggest that these sandstones were primarily exposed to mild chemical weathering at the source area and later to moderate diagenetic modifications under semi-humid climatic conditions.*

ACKNOWLEDGMENT

This work is part of a Ph.D. project for the first author who is fully sponsored by the Japanese Ministry of Education, Culture, Sports, Science, and Technology (MONBUKAGAKUSHO).