Abstract:

Rare metal mineralization of Sn, Nb, Ta and W are encountered at Gabal Dihmit area (GDA), southern Aswan. The mineralization is related to muscovite granites and their pegmatite derivations. The pegmatites are grouped into three types according to their main mineral assemblages: K-feldspar-muscovite-tourmaline, K-feldspar-albite-muscovite and albite-Kfeldspar-lepidolite veins. Petrogenetic studies indicate that Sn and Nb-Ta mineralization extend from the late magmatic stage to the pegmatite and hydrothermal stages of the GD suite. The topaz-lepidolite granite is dominantly composed of albite, lepidolite and quartz with topaz, Kfeldspar and amblygonite. The accessory minerals are zircon, monzonite, pollucite, columbitetantalite, microcline and Ta-rich cassiterite. Phenocrysts of quartz, topaz and K-feldspar contain abundant inclusions of albite laths and occasional lepidolite crystals along growth zones (snowball texture), indicating simultaneous crystallization from a subsolvus residual magma. The origin of pegmatites is attributed to extreme differentiation by fractional crystallization of a granitic magma. The economic potential of rare metals evaluated in geochemical discrimination diagrams. Accordingly, some pegmatites are not only highly differentiated in terms of alkalies but are also promising targets for small-scale of Ta and some degree for Sn. The pegmatites also provides the first example of Fe-Mn and Nb-Ta fractionation in successive generations of granites to cassiterite-bearing pegmatites, which perfectly exhibit mimics fractionation trends established for primary columbite-tantalite in the corresponding categories of pegmatites.
Abstract- The Wadi Hodein area contains a wide variety of late Precambrian igneous and metamorphic rocks, represented by gneisses, serpentinites, metagabbros, metasediments, metavolcanics, metagabbro-diorite, granodiorite and granitoids. The Wadi Hodein metavolcanics (WHV), including G. Khashab and G. El Anbat, represent one of the significant metavolcanic suites in the southern part of the Nubian Shield. They mainly belong to low-grade greenschist facies and range in composition from basalts to dacites. The basalts are mainly composed of plagioclase, augite, actinolite and hornblende together with minor quartz. Geochemically, the basalts have a transitional character from tholeiite to calcalkaline. The basaltic andesite, andesite and dacite varieties are predominantly of calcalkaline nature. The studied volcanics are enriched in LILE and depleted in HFSE, with a pronounced negative Nb anomaly. Thus, The WHV is most probably derived from a mantle source produced above a subducted slab of the lithosphere. Melting of such a hydrated mantle wedge produced a tholeiitic to calc-alkaline basaltic magma. The most basic basaltic sample has extremely low Mg# (54.3) and Ni (140 ppm) values, indicating that it has a significant fractionation of olivine and pyroxene. The investigated andesite and dacite might be formed, respectively, via fractional crystallization of basaltic andesite and andesite melts with about 41 % and 60 % removal of mostly hornblende and plagioclase.
The Neoproterozoic rocks of the Bir Madi area, south Eastern Desert, comprise a metagabbro-diorite complex (GDC) and a tonalite-granodiorite suite (TGrS). The GDC has a weak tholeiitic to strong calc-alkaline character and is made up of olivine gabbro, hornblende gabbro, diorite and monzodiorite. The olivine gabbro is characterized by abundance of augite and labradorite with pseudomorphic serpentine. The hornblende gabbro is mainly composed of hornblende, labradorite, andesine and minor amounts of quartz with or without augite. The diorite consists essentially of andesine, hornblende, biotite and quartz. The GDC is compositionally broad, with a wide range of SiO$_2$ (46-57 \%) and pronounced enrichment in the LILE (Ba and Sr) relative to the HFSE (Nb, Y and Zr). The metagabbro-diorite rocks exhibit petrological and geochemical characteristics of arc-related mafic magmas, derived possibly from partial melting of a mantle wedge above an early Pan-African subduction zone of the Neoproterozoic Shield. The tonalite and granodiorite have a calc-alkaline affinity and show the geochemical signatures of I-type granitoids. The TGrS contains amphibolite enclaves and foliated gabbroic xenoliths. Based on the field evidence and geochemical data, the GDC and TGrS are not related to a single magma type through fractional crystallization. The presence of microgranular amphibolite enclaves in the tonalitic rocks argues against their generation by partial melting of a mantle-derived basaltic source. The tonalitic magma was originated from partial melting of an amphibolitic lower crust (i.e. anatexis process) at a volcanic arc regime during construction of the Arabian-Nubian Shield. Fractional crystallization of Kfeldspar and biotite gave the more evolved granodiorite variety from the tonalitic magma. The gabbroic xenoliths are similar in their chemical composition to the investigated metagabbros. They are incompletely digested segments from the adjacent metagabbro rocks incorporated into the granitic magma through an assimilation process.

Abstract:

Key Words: Late Proterozoic, Dokhan Volcanics, Geochemistry, Petrogenesis, Sinai, Egypt.

Wadi Madsus area is occupied by a succession of volcanic and sedimentary rocks that were subjected to low pressure metamorphism. The succession is intruded by younger gabbros, younger granitoids and a series of NE-trending post-granitic dykes. The metamorphosed volcanics are dominated by andesite and dacite with minor basalt and basaltic andesite. The associated pyrocalstics are minor and represented by fine to coarse crystal and lithic crystal tuffs. The metamorphosed clastic sediments are immature and commonly foliated in ENE and WNW directions. They are represented by siltstones, wackestones and conglomerates. The petrographic investigation revealed that these sediments were derived from the erosion of the underlying volcanics.

Geochemically, the Madsus volcanics have a wide range of SiO\textsubscript{2} and a high-K calcalkaline nature. The basaltic rocks are enriched in the high field strength elements (HFSE), while the intermediate volcanics have percentages of SiO\textsubscript{2}, TiO\textsubscript{2}, Al\textsubscript{2}O\textsubscript{3}, K\textsubscript{2}O and P\textsubscript{2}O\textsubscript{5} within the range of the values of the orogenic andesites. Behavior of trace elements revealed subduction zone fluids enrichment for the studied volcanics. Chondrite-normalized REE pattern of Madsus volcanics show marked enrichment in the light rare earth elements (LREE). The abundance of andesite with significant amount of immature clastic sediments, the high-K calc-alkaline nature, high LILE/HFSE ratios and the enrichment of HFSE and LREE in the Madsus volcanics confirm that they are subduction-related and were formed in an active continental margin tectonic setting.
The Dokhan volcanic rocks, most abundantly occurring in the northern part of Eastern
Desert of Egypt, represent late Neoproterozoic products of Pan-African volcanism in the
Arabian-Nubian Shield. The Dokhan volcanic rocks in Wadi Allaqi of the southern Eastern Desert of
Egypt comprise two rock units: (1) a mafic volcanic unit (MVU) of mostly basalts, basalticandesites
and andesites and (2) a felsic volcanic unit (FVU) of mostly dacites. The investigated
Dokhan volcanic rocks are characterized by a wide range of major and trace elements. They
range from low-K variety for the MVU to medium-K calc-alkaline character for the FVU. They
define a continuous composition with respect to SiO$_2$, MgO, CaO, TiO$_2$, Fe$_2$O$_3$*, Cr, V and Y,
and all lithologies are considered co-magmatic. The low Mg#, Ni and Cr contents of the Allaqi
Dokhan volcanic rocks, together with the curvilinear trends displayed by some major and trace
element variations indicate that the rocks evolved by fractional crystallization processes. The
fractionated phases were pyroxene, amphibole, plagioclase, titanomagnetite and apatite. Their
wide variations in the Rb/Sr ratios indicate that they have randomly assimilated crustal rocks
during their evolution.

Eruption of the Dokhan volanics coincided with the late stages of the Pan-African
events and it was probably synchronous with deposition of the basal sediments of the Hammamat
Group and emplacement of the post-orogenic A-type younger granitoids. We propose that the
synchronous timing of the Dokhan volcanics and post-orogenic A-type younger granitoids with
the Najd strike-slip fault system and their undeformed character preclude a subduction-related
(compressional) tectonic setting at the time of the Dokhan volcanics formation. Thus, the
Dokhan volcanics were produced during post-orogenic transpression-/extensional-related
tectonics.
Older and younger granitoids are widespread throughout the basement rocks of NE Egypt. Therefore, they are played a significant role in the evolution of the Pan-African crust. The Wadi El Sheikh-Gabal Saint Katherine area comprise three distinctive magmatic granitoid suites, namely: (1) calc-alkaline older quartz monzodiorite-tonalite suite (COG), (2) calcalkaline younger monzogranite suite (CYG), and (3) alkali feldspar granites suite of Gabal Saint Katherine (AFG). The calc-alkaline I-type granitoids are exposed in Wadi El Sheikh area. They exhibit geochemical characteristics of arc-related magmatism such as enrichment in LILE (Ba, Sr and K) coupled with depletion in Nb and Y. The AFG are characterized by high SiO$_2$, alkalies, Nb, Rb and Y and low contents of CaO, MgO, TiO$_2$, P$_2$O$_5$, Sr and Ba. They display geochemical attributes of A-type granites, which are emplaced in a post-collision regime. The chemical change in composition of biotite from the calc-alkaline granitoids to the AFG suite (i.e. become Fe-rich) reflects considerable variations in amount of oxygen fugacity during magmatic crystallization of those rocks.

Field relationships and geochemical evidences of the studied granitoid suites indicate that those rocks were derived from independent magma sources. The COG were originated by partial melting of a basic magma source in arc-related environment. Where, the quartz monzodioritic magma was evolved to tonalite by fractional crystallization of biotite. The younger granitic melt of the CYG was generated through partial melting of an early Neoproterozoic mafic lower crust due to crustal thickening associated with magma underplating and/or orogenic compression. The high temperature and chemical characteristics of the AFG reflect that they were derived from a highly fractionated mantle source. However, the AFG were produced from a residual granitic melt of mantle-derived mafic magma through extreme fractional crystallization process.

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