INTRODUCTION

The Iraqi Zagros forms a narrow belt in the northeastern part of Iraq (40-50 km wide and 250 km long). It consists of four tectonic zones: 1. folded zone; containing very thick sediments of Palaeozoic to Tertiary periods. 2. intermediate zone; the site of accumulation of molasse sediments of marine and continental environments (Red Bed formation). 3. Qulqula uplift with eugeosynclinal sediments (radiolarite, basic volcanite etc.). 4. thrust zone comprising three formations: Walash, Naopurdan and Qandil. The Walash formation is a volcano-sedimentary sequence containing unmetamorphosed submarine basalt, spilite (pillow lava), diabase, andesite tuffs, claystone and limestone. The Naopurdan formation is a flysch sequence. These two formations intermingle laterally indicating a simultaneous origin. Qandil is the third one which was slightly metamorphosed (marble, calc-silicate-schist etc.). In the thrust-zone three igneous complexes occur from SE to NW: Penjwin, Mawat, Bulfat (fig 1). Penjwin and Mawat are ophiolites, and Bulfat is a postorogenic intrusion associated with a well developed contact metamorphic aureole. The age of ophiolite is unestablished but most probably older than Eocene (the whole slightly metamorphosed igneous sequence is over-thrusted on the Eocene-Oligocene unmetamorphosed Walash and Naopurdan formations and younger than Jurassic. The deep-sea sediment which probably covered the magmatic complexes is of Upper-Cretaceous age (Qulqula-formation).
The ophiolitic sequences are not complete in both occurrences. In Penjwin the volcanic and sedimentary and in Mawat the sedimentary sequences are displaced tectonically.

PETROGRAPHY OF THE OPHIOLITIC COMPLEXES

The ophiolites consist of three main igneous rock units:

1. Ultrabasic rocks /dunite, harzburgite, wehrlite, pyroxenite and chromite enrichments/.

2. Basic and acidic plutonic and basic hypabyssal rocks /gabbros, plagiogranite, aplite and metadiabase/.

3. Basic and acidic metavolcanites /metabasalt, spilite, keratophyre/.

1. The ultrabasic rocks are approximately 1500 m thick /terminated by a thrust-plane/. They consist of olivine /Fo$_{90-93}$/, ortho- and clinopyroxenes. According to modal composition dunite, harzburgite, wehrlite and pyroxenite can be distinguished. Dunite prevails in Penjwin and harzburgite in Mawat.

Three types of chromite occurrences are known: accessory, schlieren and podiform or massive.

The podiform- and accessory-type chromite occurring in pyroxene-rich rock are aluminochromite and schlierentype and accessory chromite in dunite are Fe-Cr chromite. The diallage-content pyroxenite forms dykes or elongated bodies at the bottom of the gabbro which is genetically connected with gabbro.
The whole ultrabasic body was deformed and serpentinized. Secondary minerals are: serpentine /chrysotil, lizardite/, tremolite, talc, Mg-chlorite.

2. The gabbro gradually developed from pyroxenite as a result of increasing amount of plagioclases. The main constituents are basic plagioclase /An\textsubscript{60-69}/, ortho- and clinopyroxene.

The banded gabbro occurs above the pyroxene gabbro. In this type plagioclase rich layers alternate with amphibole /uralitised pyroxene/ rich one. The thickness of gabbro complex is about 1000 m.

Plagiogranite is very rare, it forms small bodies. Their potassium contents are very low. Aplite dykes transsect the whole igneous complex. They contain more potassium and intruded much latter, most probably after the emplacement of ophiolite.

The geological position of diabase is not known yet. It could have developed from the gabbro with decreasing grain-size, could have formed dyke swarms or occurred at the lower part of basalt sequences. Two types can be distinguished: a/ normal diabase/plagioclase: An\textsubscript{55}, hornblende/ of oceanic tholeiite composition /Fig. 3./, b/ quartzdiabase, it contains quartz beside plagioclase /An\textsubscript{40}/ and hornblende.

3. Metabasalt, spilite and keratophyre are closing members of the sequences. The main constituents of metabasalts are plagioclase /An\textsubscript{30}/, actinolite, chlorite and quartz. Saussuritization is very frequent. According to chemical composition they are similar to the oceanic tholeiites /Fig. 3./. Spilites most probably formed by metasomatism. The quartz keratophyre is an acidic differential product of basaltic magma.

The ophiolitic sequences were affected by hydrothermal and dynamic metamorphism. Lack of wide-spread schistosity excludes the possibility of regional metamorphism.

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GENESIS OF OPHIOLITES

The ophiolitic complex represents the upper mantle and oceanic crust. It formed in the middle oceanic ridge. The deep seated rifts caused a partial melting in the mantle. The composition of melt was tholeiitic. From this melt through the normal calc-alkaline differentiation /Fig. 2./ pyroxenite, gabbro, diabase, basalt and subordinante acidic igneous rocks crystallized. The residuum is enriched in olivine /dunite/ and Fe-Cr chromite. The whole sequences moved towards the continental crust suffering solid-state deformation and hydrothermal-metamorphism. At last it collided and obducted on the continental crust.

The iraqi ophiolites represent a Mesozoic Thetian oceanic crust and mantle which was obducted on Arabian-plate as a result of collision with the Iranian-plate due to the opening of the Red Sea /Fig. 6./. The ophiolitic sequences formed during the intensive spreading in the Thetys sea /Lower Cretaceous/ and started to shrink in late Lower-Cretaceous. The latest trench was formed before the collision with the Iranian-plate indicated by the Eocene-Oligocene volcano-flysch sequences. The collision started from Miocene when the ophiolites were overthrusted on molasse sediments /Red-Bed formation/.

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Address of the author:
Buda György
Budapest
Muzeum krt., 4/a.
H-1088/Hungary.
GEOLOGICAL MAP OF IRAQI ZAGROS THRUST MOUNTAIN ZONE

Scale 1:1,000,000

LEGEND

- Qulqla (Radiolarian series) Cretaceous
- Qandil (Metamorphic rock group) Eocene
- Walash (Volcanic rock) Eocene-Paleocene
- Naopurdan (Shaly rock group) Oligocene to Eocene
- Red beds Miocene to Eocene
- Upper Fars Miocene
- Alluvium
- Igneous rocks

Fig. 1. sz. ábra

1. High-Mountain Zone
2. Ridge of Hills
3. Desert and River plains Zone.
AFM DIAGRAM OF IRAQI ZAGROS OPHIOLITIC COMPLEXES

Fig. 2. sz. ábra
Alkali Basalt

Alkalis - silica diagram for Mawat analysed samples. The line is alkalic - tholeiitic division line (MacDonald and Katsura 1964)

(○ = metabasalt, □ = average metabasalt, △ = spilite, △ = average spilite, ▽ = meta diabase, ▽ = average meta diabase, △ = average spilite (Poldervaart, 1955) ○ = average oceanic tholeite (Engel et al., 1965)
Variation of CaO and Al$_2$O$_3$ contents of ophiolites and oceanic crustal rocks. Fields are the compositional variations of rock types from both occurrences /R.G. COLE-MAN 1971/. Dashed lines show the development of Mawat ophiolitic rocks.
SCHEMATIC CROSS-SECTION OF IRAQI OPHIOLITE COMPLEX

An_{18}
Quartz tholeiite

An_{28}

An_{60}
Olivine tholeiite

An_{80}

3000 m

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Qulqala radiolarian limestone (?)
Keratophyre
Spilitic (pillow structure)
Metabasalt (amygdules)
Metadiabase
Plagiogranite
Banded gabbro
Sools
Pyroxene gabbro
Pyroxenite
Podiform Al-chromite
Fe-Cr-chromite
Harzburgite
Dunite
Serpentinite

Walash-Nappuritan volcano-flysch sequences

Fig. 5. sz. ábra
SKETCH OF PLATE MOVEMENT IN MIDDLE-EAST

Fig. 6. sz. ábra