Field relations and petrography in the Wadi Haymiliyah, Oman ophiolite: Evidence for a very heterogeneous plutonic lower crust

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According to the "ophiolite model", the lower oceanic crust formed at fast-spreading ridges is regarded to consist of a relatively simple “pan cake” sequence: from bottom to top, Moho-transition zone (MTZ), layered gabbros developing to isotropic gabbros, and sheeted dikes. Actually, this model is mainly based on Oman ophiolite studies. However, the “real” lower ophiolite crust of the Oman may show a much higher complexity which is expressed by numerous intrusions of late plutonics of different rock type. We studied a special section of lower crust of the Oman ophiolite in the Wadi Haymiliyah (Halyn block), which is well-known for its complexity (Juteau *et al*., 1988). Here, we started small-scale mapping projects for a detailed structural, petrographic and geochemical characterization of selected outcrops within the lower parts of the plutonic crust.

The data presented here result from field work in a 250 m long river section in the Wadi Haymiliyah, which is geographically situated at N 23°33,975 and E 57°11,963. The mapping project uncovers typical layered gabbros probably emplaced during the on-axis accretion stage of a fast-spreading oceanic spreading center forming the basic matrix of the crust. Subsequently, the layered gabbro sequence was intruded by magmas or crystal mushes of different lithologies resulting in a variegated suite of late-stage plutonic rocks: poikilitic wehrlites, olivine gabbros, clinopyroxene gabbros, "hydrous" gabbros, as well as oceanic plagiogranites. The contacts of the intrusions exhibit no chilled margin or any major textural discontinuity. Furthermore, plastic deformations are practically absent, implying that the layered gabbros were still very hot or even in a state of dense mush during the intrusion of the later magmas. Thus, it is indicated that the late intrusives also belong to the on-axis accretion stage. The gabbro in direct contact with the wehrlites shows those typical microstructures characterized by zones of An-enriched plagioclase on grain boundaries (Koepke *et al*., 2005), implying that water-rich fluids derived from the wehrlites triggered hydrous partial melting reactions in the gabbro.

References

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Origin and Re-Os systematics of bitumen hosted in Lower Cretaceous volcanic rocks, northern Chile

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Bitumen-bearing strata-bound copper deposits hosted in volcanic-volcanoclastic sequences of Lower Cretaceous age are common in northern and central Chile. Solid bitumen and pyrobitumen (residual petroleum) are intimately associated with Cu-(Ag) sulfides. These deposits have several similar characteristics, such as the same type and age of the host rocks, the same number and type of hydrothermal stages (an early Fe-rich stage followed by a late Cu-rich stage); and the same ore paragenesis. In all locations, the textural relationships between bitumen and sulfides indicate that bitumen was present prior to the precipitation of the Cu-sulfides.

The origin of these Cu-(Ag)-bitumen deposits is associated to the evolution of the Lower Cretaceous back-arc basin. The source of the hydrocarbons is attributed to the thermal maturation of marine organic-rich facies accumulated in the back-arc basin during Jurassic and Early Cretaceous time. The necessary heat for distillation of hydrocarbons from source rocks has a probable origin in the burial temperature, coupled with the high thermal gradient associated with the extension and thinning of the crust under the ensialic floor of the back-arc basin and/or the hydrothermal fluid circulation associated with active magmatism during the Early and Late Cretaceous. Fe-rich hydrothermal fluids first removed the hydrocarbons from their source rocks and then precipitated them in the upper levels of the Lower Cretaceous sequence. Later, Cu-rich hydrothermal fluids precipitated the Cu-sulfides and contributed to the thermal maturation and cracking of the migrated oil to form pyrobitumen. The temperature of about 130ºC obtained from bitumen reflectance indicates the temperature of the first Fe-rich hydrothermal event and indirectly the regional maturation level, whereas temperatures between 170 and 380ºC, obtained from the reflectance of pyrobitumen, indicate the temperatures of the second Cu-rich hydrothermal event, which physically and chemically altered the original bitumen.

Preliminary Re-Os analyses of bitumen from the Copiapo area show high Re and Os concentrations (~670 ppb and ~2 ppb, respectively). The $^{187}Re/^{188}Os$ ratios are very high with values between ~11500 and 12800, and the Os isotopic composition is very radiogenic, with $^{187}Os/^{188}Os$ ratios over 50. These preliminary results indicate a very radiogenic source for the Os contained in the bitumen. Further Re-Os work on other bitumen samples and Cu-sulfides is in progress to determine time constraints for the formation of bitumen and sulfides in these deposits.