Very heterogeneous plutonic crust in the Oman ophiolite: Field relations and petrography (Wadi Haymiliyah, Halyn block)

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The "ophiolite model", which is mainly based on studies on the Oman ophiolite, imply that typical lower oceanic crust formed at fast-spreading ridges consists of a relatively simple "pan cake" sequence of (from bottom to top) the Moho-transition zone (MTZ), layered gabbro developing to isotropic gabbros, and sheeted dikes. However, the "real" lower Oman ophiolite crust is much more complicated, characterized by numerous complex intrusions of different rock types. To unravel the different crustal lithologies, we studied a special crustal section through the lower oceanic crust of the Oman ophiolite exposed in the Wadi Haymiliyah (Halyn block) which is well-known for its complexity [1]. Here, we started small-scale mapping projects for a detailed structural, petrographic, and geochemical characterization of special outcrops within the lower and the upper parts of the plutonic crust.

Based on preliminary results, a first synopsis can be presented: Typical layered gabbros probably emplaced during the on-axis accretion stage of an oceanic spreading centre form the basic matrix of the crust. During a subsequent stage, different lithologies intruded into the layered gabbro sequence, either as magmas or as crystal mushes, forming now a variegated suite of late-stage plutonic rocks interfingering with the layered gabbro. These rocks comprise a remarkable span in compositions: poikilitc wehrlites, gabbronorite, Fe-Ti-rich gabbronorite, isotropic hornblende gabbro, oceanic plagiogranites (diorites, tonalites, trondhjemites), hornblende gabbros, magmatic breccias consisting of a felsic matrix containing gabbroic and diabase xenoliths. Plastic deformations are practically absent, and the contacts of the intrusions exhibit no chilled margin or any textural discontinuity, implying that the layered gabbros were still very hot or even in a state of dense mush during the intrusion of the later magmas.

[1] Juteau T, Ernewein M, Reuber I, Whitechurch H, Dahl R (1988) Duality of magmatism in the plutonic sequence of the Sumail Nappe, Oman. Tectonophysics 151: 107–135.

The ICDP drillcores from the Bosumtwi impact structure, Ghana

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The Bosumtwi impact structure (Ghana) is the youngest and best-preserved complex impact structure known on Earth. It is located in lower greenschist metasediments of the 2.1–2.2 Ga Birimian Supergroup. The Bosumtwi crater was the subject of an ICDP drilling project in 2004; two boreholes (LB-07A and LB-08A) penetrated the crater fill breccia and central uplift strata. Both cores comprise alternating sequences of metasediments and lithic and suevitic impact breccias). Impact melt is only present on the microscopic scale. Meta-greywacke forms the principal target rock component in breccias, followed by varying amounts of quartzite, carbonate, graphitic shale and other metapelites. Shock deformation in quartz clasts involves planar fractures, 1 to 2 (rarely more) sets of PDFs, reduced birefringence, and isotropism. Shock effects in feldspar clasts are rare. In central uplift strata, decorated PDFs occur, in addition to minor diaplectic glass; a decrease of shock degree in quartz with depth is apparent. There is a distinct absence of ballen quartz, in contrast to suevites from outside the crater. Nearly all impact breccia samples have similar major element composition – the result of thorough mixing of the various Birimian target rocks. Notably, no significant granitoid component has been observed in these breccias, again in contrast to the impact breccias outside of the crater rim. In conclusion, the LB-07A and LB-08A cores differ sequentially but are similar petrographically. They differ in terms of shock characteristics from impact breccias from outside the Bosumtwi crater rim. Within-crater breccias display a lower degree of shock, in terms of abundance and numbers of sets of PDFs per grain, much less diaplectic glass, and a notable lack of ballen quartz. Suevites from outside the crater contain macroscopic melt fragments with a granitoid clast component.