EGU22-6261, updated on 15 Aug 2022
https://doi.org/10.5194/egusphere-egu22-6261
EGU General Assembly 2022

Contact metamorphic reactions related to magmatic sill intrusion in the Guaymas basin

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Igneous sill intrusions into young organic-rich sedimentary basins have major impact on the carbon cycle but also on the transfer of major and trace element between deep and superficial geological reservoirs. The Guaymas Basin in the Gulf of California represents the nascent stage of an ocean characterized by siliceous organic-rich sediments (diatom ooze) deposited at high sedimentation rates. A very dense network of shallow sill intrusions recently invaded the basin. We focused on Site U1546 (Holes A and C) located at about ~51 km northwest of the axial graben of the northern Guaymas Basin spreading segment; this site recovered 540m of sediments and an 80m-thick sill located at 350-430 meters below the seafloor (mbsf). The relatively high geothermal gradient (> 200 °C/km) induces measurable diagenetic transformations in sediments, involving sulfides, carbonates and silica (and clay minerals). Based on retrieved materials from IODP Expedition 385, we present here geochemical and mineralogical characterization of the sedimentary intervals at sill contacts. Our results indicate that sulfides and silica polymorphs are the main phases impacted by contact metamorphism. The transition between opal CT-quartz and pyrite-pyrrhotite is observed in the contact aureoles. In the upper aureole, authigenic quartz and disseminated 20-50 micron pyrrhotite partly fill secondary pores and detrital feldspars are partially dissolved. Patchy carbonate also fills primary interparticle sediment pores just above the contact. In the lower contact aureole, quartz and 200-micron-size euhedral crystals of pyrrhotite are also present. Additionally, a significant metasomatism is observed in the lower contact-aureole meta-sediments with authigenic plagioclase precipitated around detrital feldspars and locally euhedral pyroxenes included in patches of carbonate cement; this suggests precipitation by late to post magmatic fluids at T>300°C. The lower contact aureole is also more enriched in CaO, Na2O, Fe2O3 and trace elements (Cu, As, Zn...). Based on these petrological investigations a new conceptual model of magma sediment fluid interactions will be proposed.