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Evolution of a crack-seal calcite vein network in limestone : a high resolution structural, microstructural and geochemical study from the Jebel Akhdar high pressure cell, Oman Mountains

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We present a workflow to acquire and create a 1.2 Gipapixel high-resolution outcrop panorama of a polished limestone pavement on the Western flank of Jabal Shams in the Oman Mountains. The outcrop panorama serves as a basemap to integrate structural, microstructural and geochemical investigations in a Geographic Information System. The outcrop provides insight to the evolution of a high-density calcite vein network in Limestone. The vein network as it appears in the outcrop evolved dynamically. Subvertical veins with variable strike directions show mutually overprinting age relationships, indicating a horizontal extension under near-lithostatic fluid pressure conditions. The high vein density and lack of abutting of veins indicates a quick restoration of bulk strength by fracture healing. Large vein apertures are formed by both vein stacking and a multitude of crack-seal cycles, as indicated by hostrock inclusions. The episodic growth of veins, which is accompanied by episodic fluid flow, is also suggested by large isotope variations across single veins. Existing veins act as mechanical discontinuities depending on orientation and their sealing driven strength regeneration. They significantly influence the formation of new fractures and largely control the geometry of the vein network. Stable isotope measurements imply alteration of the host rock by external fluids prior to the formation of the vein network. The majority of the veins show a rock-buffered isotopic signature. Low δ^{13}C values in some veins suggest an influx of oxidized light hydrocarbons. The fluid system was opened by E-W striking normal faults, which is preserved in fault related veins by increased δ^{18}O values.