

Deformation of a continental margin sequence under a thrust sheet: complex stress history in a high pressure cell revealed by vein systems in the Oman Mountains

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Seven deformation phases can be mapped in mesozoic carbonates of the Jebel Akhdar mountains in North Oman. These include an early horizontal NE-SW directed extension that produced bedding confined vein sets with evidence for anticlockwise rotation of the stress field over time, interpreted to have developed during the thrust sheet emplacement. It is followed by a phase of top-NE bedding parallel shearing which rotates these veins on the North side of the mountains. The next phase is normal to oblique slip faults followed by at least two phases of strike-slip deformation. A "background" ductile deformation (maximum burial temperatures of 250 °C) is shown by deformed fossils and diagenetic concretions. Each of these phases is consistently documented by a large number of observations of overprinting in nearly continuous outcrops.

Each deformation phase produces vein sets that do not only differ in orientation but also in occurrence and appearance. Early vein sets exhibit a high stratigraphic variability, but are laterally very stable. With the onset of faulting, the stratigraphic variability decreases and the lateral variability becomes more significant.

Even though the area offers excellent outcrop conditions with nearly 100% exposure, it is virtually impossible to find two outcrops that exhibit the same vein patterns. This has interesting implications for vein system analysis and is due to two reasons: (1) the stratigraphic and lateral variability of occurrence and orientation of each vein set cause different combination of vein sets to develop in different layers (2) Intersecting vein sets can show very different interaction such as crosscutting and reactivation, depending on the mechanical properties of the host rock and the veins.