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Coeval brittle and ductile deformation – A microstructural analysis of graphitic marbles of the central Damara Belt, Namibia

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Graphite bearing calcite marbles are regional widespread in the central Damara Belt in western Namibia. In the area of investigation they build up a series of crustal scale dome structures, which are generally developed as two types. One type developed structurally by the superimposition of isoclinal folds whereas the second type developed as granitic domes during a massive regional intrusion of granitic melts. Along the rims of both of these types of dome structures, the graphite bearing marbles show complex brittle and ductile deformation fabrics within narrow high strain zones. These high strain zones show complex macro- and microfabrics and occur in a network of conjugated shear zones around the dome structures.

The analysis of the microstructures of the graphite bearing marbles shows that three main deformation mechanisms occur in decimetre scale next to each other within the high strain zones: Ductile deformation, cataclastic deformation and pressure solution. Minor static recrystallization can be observed within the domains of ultra-fine grained cataclastic calcite. Texture analysis by neutron diffraction reveals strong similarities crystallographic preferred orientations in the mylonitic and cataclastic deformation and a general decrease of texture intensity with grain size reduction in both deformation regimes. Graphite shows in the mylonitically deformed marbles a preferred orientation of the basal plains parallel to the foliation. In the cataclastic domains ultra-fine grained graphite forms graphitic stylolite veins often in network structures of varying density, length and orientation. As the mylonitic and cataclastic deformation show

partially cross-cutting relationships, no clear progressive deformation from ductile to brittle deformation can be deduced for these marbles on a regional scale.

From the fabric analysis, calcite-graphite geothermometry and the field relationships, it is obvious that the mylonitic and cataclastic deformation occurred coeval and mutually overprint each other, which is still preserved in certain domains of the shear zones. The degree of overprinting is controlled by orientation and strength of the pre-existing fabric, relative to the local stress field. The investigated fabrics document a seismic-aseismic transition zone deformation in marble rocks.