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Fracture patterns and stress field of Deception Island, Western Antartica

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Palaeostress results derived from brittle mesoscopic structures on Deception Island (Bransfield Trough, Western Antarctica) show a recent stress field characterized by an extensional regime, with local compressional stress states. Normal faults with small offset are dominant at the exposure scale, although reverse faults planes can be recognised. The slip on the normal fault planes varies between centimetres and a few metres, while the slip on reverse faults is only a few centimetres. Slickenlines and chatter marks on the fault surfaces are absent due to rock characteristics, but it is possible to infer the relative sense of fault movement on the basis of the displacement of bedding along the faults. Palaeostress analysis was done by a method of stress inversion that can be carried out in such situations where slip lineations are lacking, but where the sense of the fault's dip-slip component is known (DISLIP software). The maximum horizontal stress (σ_y) show NW-SE and NNE-SSW to NE-SW orientations and the horizontal extension(σ_3) in NE-SW and WNW-ESE to NW-SE directions. On outcrop scale the relative chronology between extensional and compressional structures is not clear, but according to relationship between the principal stress axes and the bedding plane, it is possible to establish two different stress directions obtained from fault population analysis, a prior NW-SE and a subsequent NE-SW trending of $\sigma_{y.}$

Alignments of meso-fractures show a maximum of NNE-SSW orientation and several relative maxima striking N030-050E, N060-080E, N110-120E and N160-170E. Subaerial and submarine macro-faults of Deception Island show six main systems controlling the morphology of the island: N-S, NNE-SSW, NE-SW, ENE-WSW to

E-W, WNW-ESE- and NNW-SSE. The orientation of these fault systems is compared to Riedel shear fractures. Following this model, two evolutionary stages are proposed from geometrical relationships between the location and orientation of joints and faults. These stages imply a counter-clockwise rotation of Deception Island. This rotation may be linked to a regional left-lateral strike-slip which in turn simple shear zone could be a response to oblique convergence between the Antarctic and Pacific plates. This stress direction is consistent with the present-day movements between the Antarctic, Scotia and Pacific plates.