Evolution of Shear-enhanced Compaction Bands and Pure Compaction Bands: An example from the Willunga Basin, South Australia

Thesis submitted in accordance with the requirements of the University of Adelaide for an Honours Degree in Geology

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October 2014

THE UNIVERSITY of ADELAIDE

ABSTRACT

Shear-enhanced compaction band (SECB) and pure compaction band (PCB) evolution was constrained at Sellicks Beach, analysing measurements from 247 deformation bands recorded at 12 field locations, from outcrop of the Port Willunga Formation and Heatherdale Shale in the Willunga Basin, South Australia. Three distinct deformation band sets were identified with dominant strike orientations of NW-SE, and subordinate strike orientations of NNW-SSE and WNW-ESE. Sets one and two are defined as two sub-sets of SECBs, forming conjugate sets in outcrops of the Port Willunga Formation. Set three was defined as PCB by definition, forming perpendicular to the maximum principal shortening direction. Deformation bands were further characterised by deformation band style; i) sharp; ii) gradual, and; iii) diffuse, and deformation band fills; i) reorientated bioclasts fill (normal fill); ii) black lithic fill, and; iii) micrite fill.

Deformation band conjugate set dihedral angles, band interactions, microstructural and petrophysical properties were used to define the three generations of deformation bands and their temporal evolution. They were formed in response to rotation of stress orientations during basin formation and reactivation, and inversion of the large-scale Willunga Fault at Sellicks Beach during the Middle Eocene and Pliocene.

Thin sections revealed increasing cataclastic failure in deformation bands analysed, enabling for identification of an evolutionary sequence of; i) diffuse, to; ii) gradual, to; iii) sharp, and finally; iv) black lithic. This sequence demonstrates progressively higher amounts of cataclasis and shear.

Thin sections were further used, as well as core samples to produce porosity values of deformation band types, with reductions of porosity values coinciding with higher amounts of cataclasis and shear. Thus, the Port Willunga Formation at Sellicks Beach provides insight into deformation band characteristics and evolution in carbonate rocks, which have not previously been studied in detail.

KEYWORDS

Shear-enhanced compaction band, Pure compaction band, Willunga Basin, Port Willunga Formation.

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