Mechanical and petrophysical properties of the Alum Shale Detachment in the Khao Kwang Foreland Fold and Thrust Belt, central Thailand

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ABSTRACT

The Alum Shale Detachment within the Khao Kwang Foreland Fold and Thrust Belt (KKFFTB) has been used as an example to define the nature of the deformational mechanisms present within detachments. Primarily deformation within the detachment is brittle, although there are areas of ductile deformation within the higher strain zones. Electron Back-Scatter Diffraction (EBSD) analysis show strain partitioning from pure shear to simple shear, which is in support of macrostructural observations. The structure of this detachment can be separated into three structural zones: 1) Structural Zone 1 is characterised by metre-to-decimetre-scale thrusts, decimetre-scale fault-propagation folding and no intrusions; 2) Structural Zone 2 is characterised by metre-scale thrusts and metre-scale intrusions; and 4) Structural Zone 3 is characterised by the simplest structural geometries; decimetre-to-metre-scale thrusts and minimal intrusions. Bedding, cleavage and shear planes are all parallel, strike E-W and dip moderately to the S, throughout the detachment. The deformational intensities observed within fringe complexes on the micro-scale are intrinsically linked to the decrease in deformational intensity from Structural Zone 1 to Structural Zone 3.

Electron Back-Scatter Diffraction (EBSD), Source Rock Analyser (SRA) and Total Organic Carbon (TOC) analysis have constrained the temperature of deformation during the Indo-Sinian Orogeny (IO) between 150 °C to 200 °C. A structural evolution of the system has defined six stages based on interpreted structural analysis, Calcite Stress Inversion Technique (CSIT) and X-Ray Diffraction (XRD) analysis. These stages are: 1) E-W normal fault stress regime during the Asselian; 2) E-W strike-slip fault stress regime with episodic periods of an E-W thrust fault stress regime that occurred in the late Permian; 3) intrusions were emplaced, causing contact metamorphism and temperatures up to 334 °C. 4) A hydrothermal event occurred, causing at least two generations of veining; 5) formation of the Alum Shale Detachment, and subsequently, the KKFFTB occurred during the IO from the Late Triassic (250 Ma) to the Early Jurassic (190 Ma) and; 6) an ENE-WSW thrust fault stress regime occurred after the IO (190 Ma).

The Alum Shale Detachment has been defined as a thin-skinned type 2a detachment after Morley et al. (2013), and shows a faulted structural style (Rowan et al. 2004), based on analysis undertaken herein.

KEYWORDS

Structural Geology, Shale detachment, Khao Khwang Fold-Thrust belt, Thailand, Petrophysical properties, mechanical properties.
## TABLE OF CONTENTS

Abstract .......................................................................................................................... 1

Keywords ......................................................................................................................... 1

List of Figures ................................................................................................................ 3

Introduction ..................................................................................................................... 7

Background on Detachments ......................................................................................... 9

  Tectonic Settings ........................................................................................................ 9

  Lithology of Detachments .......................................................................................... 10

  Shale Detachments ..................................................................................................... 11

Geological Setting ......................................................................................................... 12

  Regional Geological History ..................................................................................... 12

  Stratigraphy of the Khao Kwang Foreland Fold and Thrust Belt ......................... 17

Methodology .................................................................................................................. 18

Observations and Results .............................................................................................. 23

  Structure of the Alum Shale in the Alum Shale Detachment, Eagle Cement Quarry .... 23

    Structural Zone 1 ...................................................................................................... 28

    Structural zone 2 ...................................................................................................... 30

    Structural Zone 3 ..................................................................................................... 32

  Microstructural Analysis of the Structural Zones ..................................................... 33

  Electron Back-Scatter Diffraction (EBSD) of calcite veins ....................................... 35

  Calcite Stress Inversion Technique (CSIT) ................................................................. 40

  X-Ray Diffraction (XRD) ........................................................................................... 44

  Source Rock Analyser (SRA) and Total Organic Carbon (TOC) analysis ............... 46

Discussion ...................................................................................................................... 49

Conclusions .................................................................................................................... 58

Acknowledgments ......................................................................................................... 60

References .................................................................................................................... 60
LIST OF FIGURES

Figure 1. Regional location map showing the location of the Sibmasu Block and Indochina Block in relation to the South China Block, SW Borneo Block and West Burma Block within Sundaland (Sone & Metcalfe 2008, Morley et al. 2013).............. 13

Figure 2. Schematic diagram (not to scale) showing the tectonic evolution of mainland Southeast Asia during the Permian to Early Late Triassic with respect to the Paleo-Tethys Suture Zone, the Jinghong-Nan-Sra Kaeo Back-Arc Basin Suture and deposition of the Saraburi carbonate platform. Modified from (Sone & Metcalfe 2008, Metcalfe 2011, Morley et al. 2013)................................................................. 16

Figure 3. Group Stratigraphy of the Saraburi Group (Ueno & Charoentitirat 2011). .... 18

Figure 4. a. Location map showing Saraburi in relation to Bangkok, Thailand. b. Location map showing the Eagle Cement Quarry NE of Saraburi, Thailand. Image was taken from Google Maps, 2013. c. Location map indicating the position of the Shale Quarry within the Eagle Cement Quarry, Thailand. Image was taken from Google Maps, 2013. ................................................................. 19

Figure 5. The field area situated within the Eagle Cement Quarry, Saraburi, Thailand. The coloured lines indicated the extent of each bench and the colour equivalent boxes indicate the bench number. The white circles indicate the sample locations and the sample number. 1 = RFT13-001, 2 = RFT13-002, 3 = RFT13-003, 4 = RFT13-004, 5 = RFT13-005, 6 = RFT13-006, 7 = RFT13-007, 8 = RFT13-008, 9 = RFT13-009, 10 = RFT13-010 and 11 = RFT13-011................................................................. 20

Figure 6. Schematic illustration of the affect temperature of deformation has on calcite twins. Type I represents twinning that occurred at a temperature of deformation below 200°C. Type II, III and IV represents twining that occurred at a temperature of deformation above 200°C (Ferrill et al. 2004). ................................................................. 21

Figure 7. a. Interpretation of the overall structure within the Shale Quarry, based on the 28 cross-sections. ai. Location of the Thrust 1 in Structural Zone 1. aii. Location of Thrust 2 in Structural Zone 1. aiii Location of Fault-Propagation Fold 1 that has been reactivated and subsequently, broken through the fold. aiv. Location of Fault-Propagation Fold 2 in Structural Zone 1. av. Location of the faulted contact in Structural Zone 3. b. Stereographic projection showing the relationship of poles to bedding, poles to cleavage and poles to shear planes throughout the area. c. Simplified version of the overall structure indicating the three structural zones (Structural Zone 1, Structural Zone 2 and Structural Zone 3) in which, the sections have been divided into based on the structural consistencies. Structural Zone 1 is defined by the blue colouring, Structural Zone 2 is defined by the orange colouring and Structural Zone 3 is defined by the green colouring................................................................. 24

Figure 8. a. Stereographic representation of fault planes and slickenlines within the field area, indicating they tend to show oblique fault movement to either the SW or the E, throughout the three structural zones. There are 14 fault plane and slickenline relationships that indicate oblique-slip fault movement. There are three fault plane and slickenline relationships that indicate strike-slip fault movement and four that represent dip-slip fault movement. B.Stereographic representation indicating the relationship between the poles to bedding, poles to cleavage and poles to shear planes within Structural Zone 1. The total number of bedding measurements uses is 52. The total number of cleavage measurements used is 50. The total number of shear planes used is 18. c. Stereographic representation demonstrating the relationship between the poles to
bedding, poles to cleavage and poles to shear planes within Structural Zone 2. The total number of bedding measurements uses is 17. The total number of cleavage measurements used is 38. The total number of shear planes used is 21. d. Stereographic representation illustrating the relationship between the poles to bedding, poles to cleavage and poles to shear planes within Structural Zone 3. The total number of bedding measurements uses is 45. The total number of cleavage measurements used is 57. The total number of shear planes used is 43.

Figure 9. a. Schematic diagram showing an example of the S-C fabrics present throughout the detachment. b. Photograph illustrating Thrust 1 in section W-X (Appendix B) in the second bench of the Shale Quarry. Alum Shale forms the hanging wall and the Khao Khad Limestone forms the footwall. The Alum Shale shows considerably more recrystallisation and graphitisation closest to the fault. c. Example from section EE-FF illustrating that thrusts are steepening in succession to the NE. This section also demonstrates the high level of deformation present within the intrusions. d. Example from section F-G illustrating that the intrusions present within Structural Zone 3 are highly variable, even within a 20m section. Intrusions can vary from the decimetre-scale to the metre-scale.

Figure 10 a. Antitaxial fringe complex from sample RFT13-004. Core of the fringe structure is pyrite (Py) with rims of muscovite (Mu) and illite. Photograph was captured using an Olympus BX51 reflective light microscope in cross-polarised light. b. Highly deformed antitaxial fringe complexes from sample RFT13-011. Photograph was captured using an Olympus BX51 reflective light microscope in cross-polarised light. c. Moderately deformed antitaxial fringe complex from sample RFT13-004. Photograph was captured using an Olympus BX51 reflective light microscope in cross-polarised light. d. Undeformed antitaxial fringe complex from sample RFT13-002A. Photograph was captured using an Olympus BX51 reflective light microscope in cross-polarised light.

Figure 11 a. Electron Back-Scatter Diffraction (EBSD) map from sample RFT13-002A with band contrast (BC), a semi-transparent filter and inverse pole figure (IPF) colouring. b. Pole figure plot for the EBSD map with IPF colouring from sample RFT13-002A. c. Pole figure plot with contouring of sample RFT13-002A. d. Electron Back-Scatter Diffraction map from sample RFT13-004 with BC, a semi transparent filter and IPF colouring. e. Pole figure plot for the EBSD map with IPF colouring from sample RFT13-004. f. Pole figure plot with contouring of sample RFT13-004. Electron Back-Scatter Diffraction maps were created using HKL channel 5 software; Tango, plots were created using Mambo.

Figure 12. a. Electron Back-Scatter Diffraction (EBSD) map from sample RFT13-002B-1 with band contrast (BC), a semi-transparent filter and inverse pole figure (IPF) colouring. b. Pole figure plot for the EBSD map with IPF colouring from sample RFT13-002B-1. c Pole figure plot with contouring of sample RFT13-002B-1. d. Electron Back-Scatter Diffraction map from sample RFT13-002B-2 with BC, a semi transparent filter and IPF colouring. e. Pole figure plot for the EBSD map with IPF colouring from sample RFT13-002B-2. f. Pole figure plot with contouring of sample RFT13-002B-2. Electron Back-Scatter Diffraction maps were created using HKL channel 5 software; Tango, plots were created using Mambo.

Figure 13. a. Electron Back-Scatter Diffraction (EBSD) map from sample RFT13-011-1 with band contrast (BC), a semi-transparent filter and inverse pole figure (IPF) colouring. b. Pole figure plot for the EBSD map with IPF colouring from sample
RFT13-011. d. Pole figure plot with contouring of sample RFT13-011. d. Electron Back-Scatter Diffraction map from sample RFT13-011-2 with BC, a semi transparent filter and IPF colouring. e. Pole figure plot for the EBSD map with IPF colouring from sample RFT13-011-2. f. Pole figure plot with contouring of sample RFT13-011-2. Electron Back-Scatter Diffraction maps were created using HKL channel 5 software; Tango, plots were created using Mambo.

Figure 14. Stereographic representation of the principal palaeostresses $\sigma_1$, $\sigma_2$ and $\sigma_3$ and their relationship to bedding from the first main tectonic stage defined by the Calcite Stress Inversion Technique. This stage indicates E-W extension, which occurred prior to deformation. A. Illustrates the principal palaeostresses and their relationship to bedding at present. B. Illustrates the position of the principal palaeostresses and their relationship to bedding at the time these conditions occurred.

Figure 15. Stereographic representation of the principal palaeostresses $\sigma_1$, $\sigma_2$ and $\sigma_3$ and their relationship to bedding from the second main tectonic stage defined by the Calcite Stress Inversion Technique. This stage indicates an E-W strike-slip regime with strain partitioning between strike-slip and compression, which occurred prior to deformation. A. Illustrates the principal palaeostresses and their relationship to bedding at present from sample RFT13-002. B. Illustrates the position of the principal palaeostresses and their relationship to bedding at the time these conditions occurred from sample RFT13-002. C. Illustrates the principal palaeostresses and their relationship to bedding at present from sample RFT13-005. D. Illustrates the position of the principal palaeostresses and their relationship to bedding at the time these conditions occurred from sample RFT13-005.

Figure 16. Stereographic representation of the principal palaeostresses $\sigma_1$, $\sigma_2$ and $\sigma_3$ and their relationship to bedding from the second main tectonic stage defined by the Calcite Stress Inversion Technique. This stage indicates an ENE-WSW compressional regime that occurred post-deformation. A. Illustrates the principal palaeostresses and their relationship to bedding at present from sample RFT13-002. B. Illustrates the principal palaeostresses and their relationship to bedding at present from sample RFT13-005.

Figure 17. a. Scatterplot representing the mean temperatures obtained for the illite crystalinity measurements on the air dried (AD) samples. Calculations used were taken from the calibrations given by Ji and Browne (2000). b. Scatterplot representing the mean temperatures obtained for the illite crystalinity measurements on the glycolated samples (GL). Calibrations after Ji and Browne (2000).

Figure 18. This figure illustrates the temperatures at which gas, gasoline and kerosene and diesel, lubricating and heavy oil occur at and their peak. Furthermore it indicates the subsurface process in which gas, gasoline and kerosene and diesel, lubricating and heavy oil are likely to form. Based on the SRA and TOC results, samples RFT13-001, -003, -006, -007, -009 and -010 indicate that they have experienced temperatures of exceeding 150 °C.
List of Tables

Table 1. Classification scheme for modern fold and thrust belts. For ancient type 2a and 2bi the detachment lithology can be either salt or shale (Morley et al. 2011).

Table 2. The assumptions made when separating successive generations of deformation and defining their related stress regimes, according to Anderson (1951).

Table 3. Dip and dip-direction of the bedding planes from samples RFT13-002A, -002B, -004, -008 and -011.

Table 4. Stress data collected from the Calcite Stress Inversion Technique (CSIT). Plunge and plunge directions of the three principal palaeostresses $\sigma_1$, $\sigma_2$ and $\sigma_3$, the shape ratio $\phi$ and $F$ values are shown in this table for the three main tectonic stages interpreted from sample RFT13-002 and the two main tectonic stages interpreted from sample RFT13-005. The plunge and plunge direction of the three principal palaeostresses $\sigma_1$, $\sigma_2$ and $\sigma_3$ after backtilting are also show in grey for the first and second tectonic stages.

Table 5. Represents the illite crystallinity (IC) for both the air dried (AD) and glycolated (GL) samples and the mean temperatures achieved from the two calculations used. The calculations were taken from the calibrations given by Ji and Browne (2000).

Table 6. Results from the Source Rock Analyser for each sample showing the Total Organic Carbon (TOC), free oil content ($S_1$), source rock potential ($S_2$), thermal maturity ($T_{max}$), hydrogen index (HI) and production index (PI). Samples S12083A and S120813 were the standards used.

Table 7. Table showing the total carbon, total inorganic carbon and TOC results collected from the TOC and SRA Analysis from samples RFT13-001, -003, -006, -007, -009 and -010.