

# ge



# LOGIC

News

## About SCA and geoLOGIC

SCA is a worldwide petroleum industry leader in professional consultancy and advanced training services. From major synergistic field studies to sequence stratigraphy, from property evaluations to prospect reviews, our staff of geologists, geophysicists, and engineers have the expertise and experience to provide you with the very best service and training available. Since 1988, we've helped our clients discover billions of barrels of oil and train for the challenges of the new millennium. We are proud to serve you and hope you enjoy reading geoLOGIC. For more information on SCA, please contact us today.

### SCA

2500 Tanglewilde, Suite 120  
Houston, Texas, USA 77063  
Phone: +1.713.789.2444  
Fax: +1.713.789.4449  
Email:  
[info@scacompanies.com](mailto:info@scacompanies.com)

**SPRING, 1998**

## **ACCURATELY PICKING THRUST FAULTS**

by: Richard E. Bischke, Chief Structural Geologist

### **INTRODUCTION**

Accurately picking thrust faults within fold and thrust belts is usually difficult. Often interpreters know that thrust faults are present, but are not sure how to precisely locate and map them. Often thrust faults are simply drawn through no data areas in an attempt to resolve the structural problem. But is the no data region caused by thrusting, the result of high bed dips (Tearpock et al., 1994, p- 131) or other causes? In this edition of geoLOGIC we review how to more accurately pick and map thrust faults in folded areas. These techniques will help interpreters to generate higher quality prospects on a more consistent basis and to eliminate some costly pitfalls concerning thrust faults.

### **LOCATING DECOLLEMENTS**

Dahlstrom (1969) was one of the first geoscientists to recognize how to locate thrust faults or decollements (Tearpock and Bischke, 1997, p. 406). He realized that if deformed hanging wall beds are thrust over undeformed footwall beds, then folded beds will lie above unfolded beds (Figure 1). We have called this technique for picking thrust faults "Dahlstrom's Rule". This simple, but profound observation allows us to accurately pick thrust faults. We locate in outcrop or on seismic data the discontinuity in bed dips, where dipping beds overlie beds that dip at more gentle angles (Figure 1).

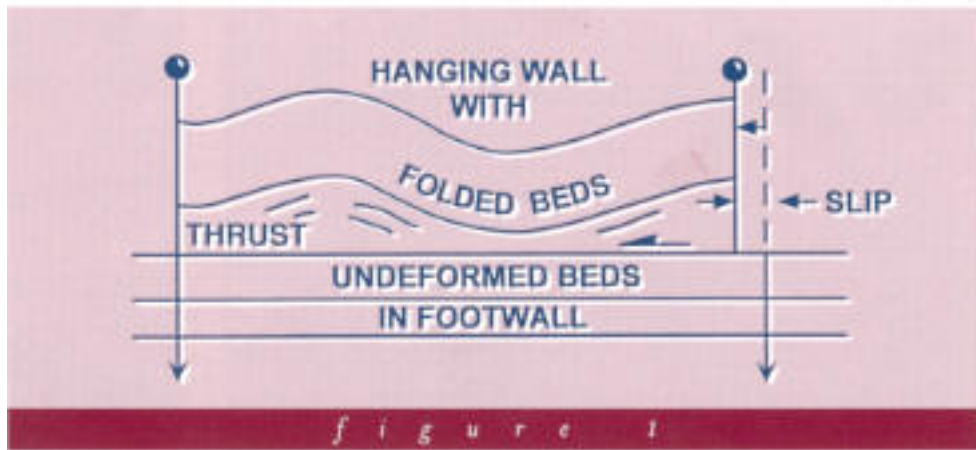


Fig. 1

## Examples

We present two (2) examples of dipping or more highly deformed beds, that lie above less deformed or more gently dipping beds. One example is from outcrop and the other example is from seismic. For purposes of demonstration, we present two (2) examples of Lateral Ramps, that laterally terminate fold – thrust belts in the strike direction. Often the lateral or strike ramps are better imaged on seismic data than are thrust faults on dip lines.

The seismic line (Figure 2), that trends east to west, is from the western termination of the North Monagoas Fold – Thrust Belt, Venezuela. The North Monagoas fold-thrust bed produces hydrocarbons from the Furial – Carito – Tejero Fields that are thrust to the southeast. Major bed dip discontinuity can be observed at about 2.5 sec and several other smaller thrust faults seem to image at the 1.8 sec level. Dipping reflections overlies reflections that dip at more gentle angles indicative of a major discontinuity.

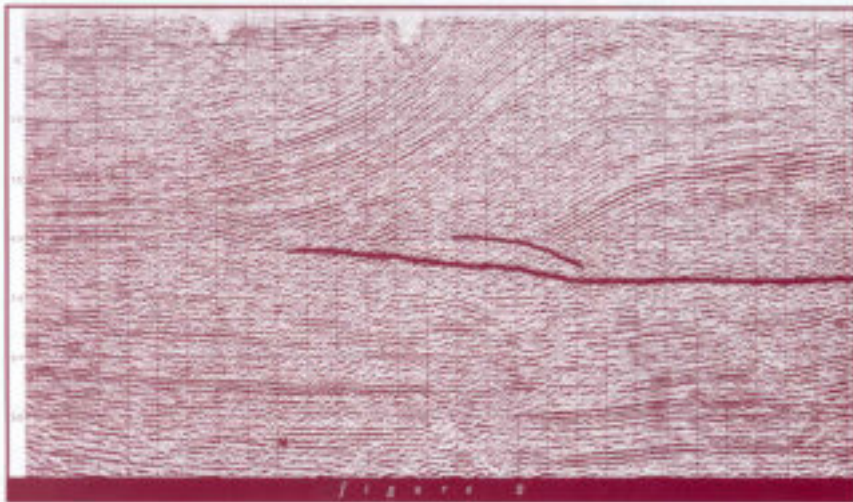


Fig. 2

The outcrop example is in the Wyoming Thrust belt where folded hanging wall beds are seen to truncate along nearly horizontal footwall beds (Figure 3). The hanging wall is moving toward the observer. The truncation of hanging wall beds upon footwall beds is direct evidence of bed dip discontinuity and detachment.



Fig. 3

## PROCEDURES

We recommend the following procedures for locating and mapping thrust faults on seismic sections. First, peruse the seismic data set in the strike and dip direction looking for bed dip discontinuities. Dip domain analysis helps in location changes in bed dips (Tearpock et al., 1994, p. 126). If you are working a 3-D data set, examine several arbitrary lines taken along the flanks of the structure in an attempt to locate lateral ramps. Lateral ramps are often better imaged in seismic data than are dip ramps. The following procedures should help generate a viable or admissible interpretation. After one or more dip discontinuities are located, fault mapping can proceed. The strike or arbitrary lines can then be loop tied to dip lines in order to map the fault. The fault surface is loop tied for the same reason that horizons are loop tied, that is, ensure that you are mapping the same event from line to line (fault or horizon).

Our examination of several hundreds, if not thousands, of fault surfaces in good data areas demonstrates that fault surfaces are smooth surfaces that do not contain kinks. Kinks in fault surfaces typically mean that two (2) or more faults are present. Also, remember that faults cannot cut across coherent reflections, and probably not across reflections that are semicoherent and likely to be continuous.

Another good rule to remember is that if an interpreted fault surface contains a ramp and if the beds moved up the ramp on the fault surface, then the reflections in the hanging wall must subparallel the dip of the ramp. An analogy would be a car moving up a ramp, onto a free-way. The pitch or dip of the car must conform to the pitch or dip of the ramp. The car cannot move up the ramp and remain the angle of the flat freeway. Thus, if beds move up a ramp of a thrust fault, the reflections of the beds should parallel or semiparallel the angle of the ramp. If the reflections are flat or subhorizontal, then there is no fault ramp.

Finally, remember that in the end the interpretation must be admissible, have three-dimensional structural validity, must balance (Tearpock and Bischke, 1994.) and be retrodeformable (Tearpock et al., 1994. p. log). A simple fifteen (15) minute cut and paste retrodeformation of your interpretation to test its validity is certainly worth the cost of a multi-million-dollar dry hole.

2. Tearpock, D j., and R. E. Bischke, 1991, *Applied Surface Geoloical Mappig*, Prentice-Hall, Englewood Cliffs, NJ.
  3. Tearpock, D .J., and R. E. Bischke, and J.L. Brewton,1994, *Quick Look Techniguesfor Prospect Evaluation*, SCA, Lafayette, LA.
- 

## *We Practice What We Teach*

### **To Register,**

Please click the link to the desired course below or contact:

[training@scacompanies.com](mailto:training@scacompanies.com)

Ph. +1.713.789.2444

Fax +1.713.789.4449

Visit our website or call for additional courses and full descriptions and details

[www.scacompanies.com](http://www.scacompanies.com)

---

Our newsletter geoLOGIC is distributed four times per year for employees, associates, friends and colleagues. If you wish to be removed from our newsletter mailing list email us at:

[newsletter@scacompanies.com](mailto:newsletter@scacompanies.com)



### **Subsurface Consultants & Associates**

#### **Corporate Headquarters**

2500 Tanglewilde Suite 120  
Houston, Tx. 77063

#### **New Orleans**

639 Loyola #2130  
New Orleans, LA, 70113

#### **Calgary**

505 3rd Street S.W. Suite 800  
Calgary, Alberta. T2P3E6 Canada

#### **Jakarta**

Wisma GKBI 3710  
Jl. Jend. Sudirman 28

Visit us on the web at:

