

Geological Cross Sections; Combining Geologic Models and Best Practices to Finding and Exploiting Reserves

Robert Shoup¹

¹Subsurface Consultants & Associates LLC, Malaysia

ABSTRACT

Cross section construction and interpretation seems to be a declining art form. Yet geologic cross sections are easy to construct, even without software or well control. When those cross sections are interpreted with the appropriate structural and depositional models they can be a powerful tool for not only understanding the subsurface, but adding reserves and ensuring optimal development strategies.

Basin scale cross-sections can not only help the geoscientist understand the basin history and charge timing by palinspastically reconstructing those cross sections, they can highlight the potential for stratigraphic pinch outs that could open new plays. Regional or trend-scale cross sections can be used to define reservoir fairways within the trend. Cross sections constructed across prospects can not only be used for well planning purposes, but to validate the geologic and structural validity of the prospect pre-drill. Multiple cross sections constructed across fields, especially mature fields, can help interpreters find additional attic reserves, identify unproduced compartments, and ensure the maximum efficiency in the draining the field.

We will review the three types of cross sections, structural, stratigraphic, and chronostratigraphic, and illustrate by way of numerous examples how each cross section type can lead to the discovery of new fields or to the addition of reserves in existing fields.

Structural cross sections are cross sections with a constant depth or elevation as the datum. Structural cross sections, especially those constructed with the appropriate structural methods provide an excellent means to visualize the structure, validate the interpretation and structure maps, to understand the distribution of fluids in the field, and to help ensure maximum efficiency in development. We will examine the methods needed to construct balanced cross sections in both compressional and extensional regimes and illustrate how proper application of structural methods in constructing cross sections has led to reserve additions.

Stratigraphic cross sections are cross sections with a correlative stratigraphic marker as the datum. Stratigraphic cross sections can help ensure that we have properly correlated the reservoirs. They can also help us to see how continuous the reservoirs are across a field or play fairway, and which reservoirs are in communication. We will examine how to leverage our understanding of depositional systems combined with cross section interpretation to ensure maximum drainage efficiency in developments or in planned enhanced recovery projects.

Chronostratigraphic cross sections are cross sections hung on geologic time. Chronostratigraphic cross sections can help us understand the entire petroleum system of a basin or play, thereby helping us to recognize potential new plays.

We can also use cross sections to understand the relationship of other key parameters to the basin structure and stratigraphy. Plotting geothermal gradients or bottom hole temperatures on cross sections allow us to see where the top of the oil and gas windows are. By palinspastically reconstructing the cross section, we can see when hydrocarbons were generated. Plotting pressure gradients on cross sections allow us to see where we can expect the top of overpressures to occur. Posting the seismic stacking velocities on a cross section can help to determine if there is a seismic velocity gradient across a field or basin.

A number of cross-sections from around the globe will be shown that illustrate how the cross sections have added reserves to an existing field or led to better definition of the reservoir and fluid distributions in discoveries and fields.