

An Integrative Analysis of Basin and Dome Structures: Examples from Field Exposures, Venus, Numerical and Experimental Models, and the Subsurface Gulf of Mexico

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ABSTRACT

Terrestrial and Venusian outcrop exposures provide excellent opportunities for comparative analysis with subsurface Gulf of Mexico salt structures. In particular, terrestrial outcrop analogues provide true geologic context rather than primarily geophysical and petrophysical investigation of subsurface examples. Although study of Venusian exposures is limited to remote-sensing means, the absence of water and thus absence of water erosion preserves structures related to basin and dome formation, allowing a unique opportunity for comparative study with terrestrial examples. An additional approach for comparative analysis of both terrestrial and Venusian examples are numerical and experimental models. These models of basin and dome development predict distinct progressions of associated structures.

Simple circular basinal structures commonly exhibit circumferential normal faults (or other extensional fabrics), and less commonly exhibit interior radial contractional and medial strike-slip features. Conversely, simple circular domal structures commonly exhibit interior radial normal faults, and less commonly circumferential contractional and medial strike-slip features. An elliptical geometry rather than a simple circular shape and/or the presence of applied regional stress changes the nature and orientation of various structural zones, generally imparting a bilateral symmetry to structural patterns. Overall these structural fabrics, observed in both terrestrial and Venusian examples, define specific strain regimes from which inferences regarding stress field variations can be made. Many observations match predicted patterns indicated by certain experimental and analytical models. Description and interpretation of more complex structural interactions can be used to understand further spatial and temporal variations in the both local and regional stress fields.

Additional similarities also exist between outcrop examples, both of terrestrial and Venusian origin, and subsurface Gulf of Mexico basins and domes, including withdrawal synclines with basinal in-filling, diapirs and other upwellings, welds, and various structural/stratigraphic interactions.