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UPDATED 3D MODEL OF THE GEOLOGICAL AND GEOPHYSICAL FRAMEWORK OF THE SOUTHERN ESPAÑOLA BASIN NEAR SANTA FE, NEW MEXICO

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For the past several years, we have been using geological and geophysical data to model the three-dimensional (3D) geometry and subsurface structure of the southern Española rift basin. Our 3D geological model utilizes software that allows multiple surfaces to represent the distribution and thickness of geologic units, offset of these surfaces along faults, and display of subsurface control data (well picks, geophysical inversions). A digital elevation model (DEM) of topography forms the top of the model. We have recently updated the model mainly to incorporate revisions to geophysical interpretations that refine previous concepts of the 3D geology and improve the accuracy and visualization of the model.

The rift basin is mostly filled with sediment of the Tesuque Formation (upper Oligocene-Miocene), the primary aquifer for the region. The shape of the basin floor above bedrock (Oligocene through Precambrian) controls the thickness of the Tesuque aquifer and is modeled primarily through analysis of aeromagnetic and gravity data constrained by other geological and geophysical data. Recent modifications and improvements to this analysis include (1) updating interpretations of lithology in wells, electrical geophysical soundings, and seismic data; (2) merging with existing geological and geophysical interpretations in the area of the La Bajada constriction on the southwest; (3) considering the connection to basin structure adjacent to the study area on the north and northwest; and (4) better integrating gravity and aeromagnetic analyses throughout the study area.

Structurally, the basin model has an overall form of a north-plunging syncline that descends abruptly across a faulted curvilinear hinge zone southwest of Santa Fe. An extensive, shallow (<75 m) platform underlies the Santa Fe Embayment south of the hinge zone. The platform is composed of Oligocene-age volcanic rock overlain by young rift sediment of the Ancha Formation (Pliocene-lower Pleistocene) and underlain by as much as to 2 km of pre-rift sedimentary rock. The volcanic platform is locally deeply incised; one paleovalley probably contains >150 m of Tesuque Formation in the Eldorado area and the volcanic rock is entirely missing beneath Ancha Formation in two other areas. The pre-rift section is truncated on the north at a buried paleo-escarpment, which generally coincides with the hinge zone. North of the hinge zone, the syncline broadens and descends north-northwestward to depths of 2–2.5 km. Its eastern limb rises with variable dip to the north-trending mountain front of the Santa Fe Range. The model includes >20 intrabasin faults that have sufficient length and offset to significantly affect the basin. A central zone of discontinuous faults transects the basin length and includes the San Ysidro Crossing fault zone, which has a hydrologic head drop across it. The southwestern flank of the model incorporates east-dipping strata that probably reflect protracted footwall uplift of the La Bajada fault zone before eruption of the mostly 2.8-2.4 Ma Cerros del Rio volcanic field that is imaged along the western flank of the model.