Cedar Valley is a N-NE-trending topographic depression on the southeastern margin of the Basin and Range Province. From 1980 to 1998, the valley's population increased by 75% and water use by public-supply systems increased by 110%. Continued rapid growth and development are creating potential water-supply and water-quality problems.

Cedar Valley's principal aquifer is in Tertiary sedimentary basin-fill deposits, composed of interbedded sand, gravel, silt, and clay deposited in stream, alluvial-fan, and lacustrine environments. Most recharge is from infiltration of Coal Creek, which drains the Markagunt Plateau east of Cedar Valley, into alluvial-fan deposits near Cedar City. The drainage basin is closed to surface outflow except during extreme precipitation events, but minor underflow occurs through topographic gaps along the valley's NW and S margins. Interpretation of seismic-reflection data collected by Mobil EPS, Inc. reveals that the Tertiary basin fill is up to 3,800 feet thick, contains three unconformity-bounded units, and has a complicated subsurface structure including two major sub-basins and several smaller intrabasin highs and lows.

Transmissivity of the basin-fill aquifer is greatest in alluvial-fan deposits along the SE and SW valley margins, and decreases toward the valley center as sedimentary deposits become progressively finer grained. Cedar Valley formerly contained flowing wells in its center and springs along its eastern margin, but pumping has lowered the potentiometric surface below the land surface and dried the springs since 1975. Bedrock units are of secondary importance for water supply, but are hydrologically connected to the basin-fill aquifer and may locally accommodate underflow across the basin-bounding fault system into the basin-fill aquifer.

Ground-water quality in the Cedar Valley basin fill is generally good, with total-dissolved-solids concentrations of 150 to 3,750 mg/L, but nitrate concentrations range from 0 to 59 mg/L. Most of the wells yielding high-nitrate ground water are near Enoch; nitrate sources likely include septic-tank systems, fertilizer, and nitrogen-bearing strata in the Cretaceous Straight Cliffs Formation. Evidence for the Straight Cliffs Formation as a possible nitrate source includes: (1) negligible changes in nitrate concentrations both historically and seasonally, despite implementation of a sanitary sewer system in the Enoch area in 1995, (2) high nitrate concentrations in ground water tapped by both deep and shallow wells, (3) high nitrate concentration in water from a well on the Fiddlers Canyon alluvial fan, upgradient from any septic-tank systems, and (4) high nitrate concentrations in some organic layers in the formation.

We applied a mass-balance equation to three areas in Cedar Valley, using site-specific ground-water flow available for mixing and site-specific ground-water-quality data, to estimate recommended septic-system density/lot size. Allowing for degradation of 1 mg/L with respect to nitrate, the mass balance approach yields average minimum lot sizes of 5.6 acres per system near Hamiltons Fort, a primary recharge area for the basin-fill aquifer, and 54 acres/system near Bauers Knoll, a secondary recharge area. The mass-balance approach is not the best land-use management tool for Mid Valley Estates, a possible ground-water discharge area, where the amount of water from septic-tank effluent is three times greater than the ground-water flow available for mixing. A public sewer system is a better alternative for domestic wastewater disposal in most areas in arid Cedar Valley, especially the Mid Valley Estates area.

HYLLAND, MICHAEL D.

Suggested Revisions to Lithostratigraphic Boundaries of the Upper Cretaceous Dakota Formation on the Kolob Terrace, Southwest Utah

The lithostratigraphic boundaries of the Upper Cretaceous Dakota Formation in southwestern Utah have long been problematic. Detailed studies in recent years have helped characterize the sedimentology and stratigraphy of the Dakota Formation in the Kaiparowits Plateau region, but outcrops to the west on the Markagunt Plateau remain relatively little studied. Recent geologic mapping on the Kolob Terrace adjacent to Zion National Park indicates that the stratigraphic positions of both the lower and upper contacts of the Dakota Formation should be revised. This reinterpretation will likely lead to improved understanding of lateral facies changes within basal Cretaceous strata across southern Utah, which in turn should provide new insights into the nature, timing, and interplay of tectonic and eustatic depositional events in the Cretaceous foreland basin of the Sevier orogen.

In southern Utah, the lower contact of the Dakota Formation has traditionally been placed at the base of a laterally persistent unit of quartzite- and chert-pebble conglomerate and conglomeratic sandstone, coincident with the basal Cretaceous unconformity. Strata that overlie the conglomeratic unit consist of a relatively thin sequence of drab to variegated, bentonitic mudstone locally containing carbonate nodules and barite crystals, interbedded with minor sandstone, organic shale, and volcanic ash. Recent pollen analyses indicate an Albian or older age for these strata; radiometric dating results from an ash layer are pending. Age and lithologic similarities suggest that these strata and the underlying conglomeratic unit are correlative with the Lower Cretaceous Cedar Mountain Formation. Thus, the basal Dakota contact should be placed above the mudstones, at the base of the overlying coal-bearing sequence dominated by fluvial (overbank) sandstone and siltstone.

On the Markagunt Plateau, the upper contact of the Dakota Formation has traditionally been placed just above the upper of two laterally continuous, relatively thick coal zones within the Dakota. However, this convention places a ledgy sequence of interbedded sandstone, siltstone, organic shale, and thin coal within the lower part of the Tropic Shale, below more typical Tropic outcrops characterized by slope-forming, septarian nodule- and ammonite-bearing, fine-grained sandstone and shale. Invertebrate faunal assemblages that include Crassostrea and Inoceramus pictus, as well as palynomorph assemblages, indicate that the ledgy sequence includes shallow marine, brackish, and fresh-water deposits of Cenomanian age. This sequence is therefore more appropriately considered to be an upper member of the Dakota rather than basal Tropic Formation, and the contact should be placed at the base of the slope-forming marine shale and sandstone above the highest coal and ledge-forming sandstone. In the vicinity of Zion National Park, the upper Dakota-Tropic interval records a change from estuarine swamp/marsh depositional environments to a more open-marine environment around the time of the Cenomanian-Turonian boundary.

KARLSTROM, K.E., QUIGLEY, M.C., BOWRING, S., KIRBY, E., HOOK, S., and HEIZLER, M.

Low angle detachment along the Great Unconformity near the Colorado Plateau- Basin and Range breakaway: arguments against a tipped crustal section in the Gold Butte area, southern Nevada

Low angle extensional faults in the southern Virgin Mountains follow the Great Unconformity over lateral distances of >1000 km^2. Detachment took place along subhorizontal bedding horizons in Cambrian Tapeats, Bright Angel, and Muav formations such that thinned flat-lying para-autochthonous sections of these lower Paleozoic rocks remain in the footwall adjacent to Proterozoic basement over a wide region. Above the detachment, extensional allochthons containing upper Paleozoic through Tertiary (18 Ma) rocks exhibit 30-80° E-tilting due to westward translation. This implies that major breakaway faults in this region initiated and moved at low angle and had ramp-flat geometry analogous to thrusts. Thus, isostatic footwall uplift is not required to explain the presence of low angle faults. Instead, Paleozoic cover was translated westward in domino blocks sliding generally along the Great Unconformity for tens of km west of the Grand Wash fault. Similar relationships are observed in the North Virgin Mountains and other para-autochthonous Proterozoic culminations north of the Gold Butte block, suggesting that this low-angle fault system forms a regional ramp-flat detachment system west of the Colorado Plateau. Ar-Ar dating of K-feldspars across the Gold Butte block show Proterozoic cooling ages and a general younging to the west, consistent with deeper exposed levels. Thermal models suggest the west end of the block was at depths <10 km prior to Miocene extension rather than at 15-18 km deep as suggested by the tilted crustal section model.

KELLER, G. RANDY

Lithospheric Architecture of the Colorado Plateau and Its Margins

Because of its tectonic significance, the lithosphere of the Colorado Plateau and its margins has been the subject of much recent debate and interest. On the Plateau itself, recent seismic results present conflicting values for crustal thickness. Some of this variation probably reflects actual complexities in crustal structure. However, some of these results suggest the presence of a high-velocity (>7.0 km/s) layer at the base of the crust. A variety of technical and physical considerations make such a layer hard to detect unless it is ~10 km thick. Our group has used receiver function analysis to determine crustal thickness and Vp/Vs ratio estimates for the southern Colorado Plateau based on the analysis of teleseismic P-waves recorded at Canyon de Chelly National Monument, Arizona and at Chaco Culture National Historic Park, New Mexico. These new data were combined with seismic refraction and gravity data in an integrated analysis of lithospheric structure. The receiver functions were stacked together in clusters of similar back azimuths and epicentral distances. Using crustal velocity values from previous studies as constraints, the receiver functions from the two stations suggest an upper crustal layer approximately 24 km thick with a Vp/Vs ratio of 1.85 (which corresponds to a Poisson's ratio of 0.29). The lower crust is about 23 km thick with a Vp/Vs ratio of 1.88 (corresponding to a Poisson's ratio of 0.3). The thickness for the whole crust is approximately 47 km. Although errors in this number may be as large as +/- 5 km, this result supports arguments based on seismic reflection and refraction data for a thick crust (45-50 km) for the Colorado Plateau, and for a crust that is more mafic in composition than typical continental crust. Based on buoyancy arguments, gravity data in the region agree with seismic results and suggest that no major variations in crustal thickness occur across the southern plateau. This crustal structure is in fact very similar to that of the Great Plains in eastern New Mexico, which is an area that shares many of the geologic characteristics of the Plateau. The Basin and Range province has also been the target of several recent seismic experiments. The results from the SSCD, DELTA FORCE, and PACE experiments in the Basin and Range province of southern Nevada, California, and western Arizona show that while the crustal thickness is surprisingly uniform, there are some intriguing variations. The velocity models derived from these experiments coupled with analysis of gravity data reveal some intracrustal features that can be correlated with extensional regimes. In particular, the lower crust in the seismic models thickens in regions where extension is greater. The regions with thickened lower crust also correlate with long wavelength gravity highs. These results suggest that the mechanism for maintaining crustal thickness during extension can be either magmatic underplating or lower crustal flow or a combination of these processes. The margins of the plateau are associated with a variety of lithospheric structures. The Wasatch Front margin is particularly interesting and can be interpreted as a "rift within a rift" because of its velocity structure and the abrupt transition in crustal thickness into the Plateau. The southwestern and eastern margins are more gradual in terms of variations in crustal thickness but both have strong reflectors in the lithospheric mantle. These reflectors can be interpreted to lie at or near the lithosphere-asthenosphere boundary.

KENDELL, CARL F.

Structure and Stratigraphy of Late Tertiary Rocks in the Subsurface: Rush Lake Area, Iron County, Utah

In 1992-1993 a 2-D seismic grid was shot in the Rush Lake-Parowan Gap area of Iron County, Utah. The grid is comprised of 7 lines of high resolution 40 fold vibroseis data totaling about 36.5 line miles. The shoot was supplimented with about 12 miles of preexisting purchase data to fill in some gaps in the grid.

The resulting processed record sections from the shoot not only show the half-graben nature of the valley and it's bounding faults, but also clearly defines much detail in the faulting which occurs within the Late Tertiary sediments themselves. The thickest section of sediments, and apparent depocenter of the basin, is located beneath Rush Lake. Rising