The pressure/depth ratio commonly increases with depth and approaches the lithostatic gradient. In many cases $\Delta P/\Delta D$ exceeds 22.6 kPa/m (1.00 psi/ft) below 3 km.

Crustal strengths in the hypocentral region, derived from peak acceleration and velocity of the mainshock and 29 aftershocks, show an unexpectedly large range of about 400 fold: from about 210 MPa for the mainshock to as low as 0.5 MPa. If AHP extend to seismogenic depths below Coalinga Anticline, as indicated by a continuous LVZ at 3-6 km depth and emission of metamorphic fluids from Franciscan and adjoining rocks (obvious sources of AHP), then the 400-fold range in apparent crustal strength can be explained by variations in effective stress and related effects.

S22A-05

Santa Barbara Channel Earthquake Locations, 1979-1982

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Hypocentral locations which are calculated with a three part model based on ray tracing of refraction shots at sea, Pn, and teleseisms and using arrival times from ocean bottom seismometers as well as land stations show two east-west trending clusters of activity. The southern cluster lies below the offshore Pitas Point and Oak Ridge faults, with most events between 5 and 10 km depth. The northern cluster is near the coast line at Santa Barbara, with most events between 8 and 14 km depth. These events are below the surface traces of the Mesa and Arroyo Parida faults, but might be associated with a north dipping thrust fault zone at depth.

S22A-06

Western Transverse Ranges Crustal Model

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Analysis of seismic data from reflections, crustal refractions, Pn, and teleseisms, combined with gravity anomalies which provide a boundary condition in typical oceanic lithosphere, yields a north-south crustal model across the western Transverse Ranges near Santa Barbara. Total crustal thickness increases northward from 23 km under the northern Borderland to 31 km under the southern Coast Ranges. A low density, low velocity feature extending to more than 10 km depth occupies the north half of Santa Barbara Channel. A thin high density, high velocity body lies south of the Santa Cruz Island fault. Lower crustal material with velocity near 7.0 km/sec is hypothesized to be Neogene oceanic rocks created at the East Pacific Rise.

S22A-07

Gravity Study of the Northern Boundary of the Western Transverse Ranges, California

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Three detailed north-south gravity profiles were completed across the Santa Ynez River fault, which is the structural boundary between the Santa Maria Basin and the western Transverse Ranges to the south. Gravity is approximately 25 milligals lower in the Santa Maria Basin and a steep gravity gradient is associated with the inferred trace of the fault. Results from forward and inverse modelling suggest that the Bouguer gravity arises from a combination of three sources: a deep contribution from the slight landward deepening of the Moho; an upper crustal contribution from the density contrast between the low-density Miocene Monterey and Sisquoc Formations north of the fault and the shallow basement beneath the western Transverse Ranges; and a mid-crustal contribution, extending from 4 to 11 kilometers depth. The mid-crustal contribution may arise from a layer of high-density crust postulated to exist beneath the western Transverse Ranges. I propose that prior to the clockwise rotation of the Transverse Ranges into their present east-west orientation, they existed as a north-south trending belt and comprised Great Valley forearc strata, with Franciscan melange rocks to the west, both underlain by oceanic crust. The forearc strata and underlying oceanic crust were thrust westward over the melange rocks in response to northwest-southeast crustal shortening. The overthrust layer of oceanic crust is now the basement of the western Transverse Ranges and is the source of the mid-crustal contribution to the Bouguer gravity. The thrust fault at depth could have provided a detachment surface upon which the rotation of the western Transverse Ranges occurred. The Santa Ynez River fault, the north boundary of the rotated terrane, may flatten at depth into this thrust fault.

S22A-08

A Gravity Survey Of The Tehachapi Mountains, California.

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A gravity survey of the Tehachapi Mountains indicates that they are characterized by a northeast trending gravity high with isogals parallel to bedrock outcrop. Flanking lows occur in the San Joaquin and Antelope Valleys. Gravity relief across the region is ~70 mgal, with gradients into the lows of 3-4 mgal/km, and ~1 mgal/km along the range.

The data indicate a strong correlation of gravity with geology and structure. Mafic metamorphics exhibit residual highs whereas granitic plutons are characterized by lows. Roof pendants exhibit either residual highs or no anomalies, depending on their lithology. The Garlock Fault separates high-density mafic metamorphic rocks to the north from low-density granitic plutonics to the south and is marked by an enhanced gravity gradient with 16-18 mgal of relief across the fault. The gradient follows the Pastoria Fault westward from its intersection with the Garlock, indicating that the Pastoria, rather than the western most Garlock, is the fundamental crustal boundary in the western Tehachapi-San Emigdio Mts. This observation is consistent with that proposed by Sharry (1982, G.S.A. Abstracts with Programs, v.14, p. 233).

Gravity data suggest that the crust beneath the Tehachapis is ~35 km thick, ~5 km thicker than that underlying the San Joaquin and Antelope Valleys. The southwestern Tehachapis are characterized by only a single high density crustal layer exposed at the surface as the mafic metamorphics. The northeastern part is characterized by a two-layer crust: a shallow low-density layer (the granitic plutons) and a deeper higher density layer (the metamorphics exposed to the southwest). The range appears to be in regional isostatic equilibrium. A 5-km thickening of the crust is consistent with that expected from an isostatic response to the topography. Additionally, crustal models indicate the pressure at 50 km along profiles across the region is constant, exhibiting variations of <2%.

S22A-09

Seismicity of the Southern San Andreas Fault, California

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Microearthquake activity along the southern San Andreas fault (SSAF) between the San Bernardino Mts. and the Salton Sea has been systematically located northeast of the easternmost mapped surface fault trace. That much of this seismicity orginates on the SSAF has been often taken for granted. The offset in earthquake epicenters has then been used to infer either an easterly dip to the SSAF itself, or a possible location bias resulting from strong lateral velocity inhomogeneities. Recent data, however, from newly installed stations close to the earthquake activity show that 1) the seismicity defines a zone 10-15 km in width; 2) the zone is sharply bounded to the SW by the SSAF; and 3) the epicenters align along a well defined system of short en echelon faults oriented northeasterly. Focal mechanisms of the larger events confirm that the motion along these northeasterly planes is left-lateral. These results suggest that the SSAF is currently aseismic and that the present activity is in fact occurring on a set of secondary structures oriented nearly orthogonal to the major fault strands. Geomorphology of the SSAF surface traces indicates that significant right-lateral movement occurs repeatedly only within a narrowly defined fault zone. This suggests a bimodal distribution of deformation where "interseismic" activity takes place on secondary structures, but major right-lateral slip occurs along the mapped surface faults. This implies that earlier interpretations of earthquake activity along the SSAF may need to be revised, and that the role of the magnitude 6.5 Desert Hot Springs earthquake of 1948 may need to be re-examined.

S22A-10

A New Paradigm for Understanding Southern San Andreas Fault Tectonics

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Earthquake hypocenters and first-motion data from the CIT-USGS network reveals an unusual pattern of deformation along fault zones in southern California. Major strands of the San Andreas fault south of Cajon Pass are currently aseismic. Earthquakes shallower than 10-12 km exhibit left-lateral oblique strike-slip motion along short faults oriented northeasterly. This pattern, in conjunction with normal and reverse focal mechanisms, suggests rigid blocks undergoing contemporary clockwise rotation as a result of regional right-lateral shear. The presence of the rotating blocks presupposes a detachment surface at depth. In fact, microearthquakes below ≈10 km are distinctly different. At greater depths, N-S shortening near San Corgonio Pass is accommodated by a combination of strike-slip and shallow-angle thrust faults. Few earthquakes, however, can be directly related to slip on the detachment itself. Velocity structures determined from earthquake arrival times suggest a low-velocity zone at or above ≈10 km below the San Bernardino Mts., but not below the San Jacinto Mts. This is nearly the same depth as the transition between the two layers of different kinematic behavior and suggests the overthrusted San Bernardino Mts. are allochthonous. This model provides several new concepts for understanding the kinematic behavior and fault tectonics for southern California. Shallow-angle structures like detachments need to be examined and, in the analysis of regional strain data, rotations must be considered. More importantly, the pattern of deformation presently observed during the interseismic period differs from the type expected from a large earthquake. Current seismicity cannot be then used to extrapolate the effects of a large event on the San Andreas. However, a systematic change in this pattern of predominantly left-lateral slip may signal an approaching failure and the occurrence of large right-lateral displacements.

S22A-11

Block Rotations and Discontinuous Faults: Solving the Problem of Slip Continuity with Examples from Southern California

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Several major transcurrent faults in California exhibit significant offsets or side-steps at the surface. Accurate hypocentral locations of small earthquakes confirm that in many cases these offsets are continuous down to the deepest seismogenic depths, suggesting there is no real coalescing of the individual fault strands. These side-steps affect the rupture propagation in large earthquakes and the time-space distribution of aftershocks. Right-stepping faults in a right-lateral system are commonly associated with pull-apart basins; however, an exception is Coyote Ridge between the right-step of the Coyote Creek and San Jacinto faults. We propose a block rotation model where the crustal wedge between the two parallel overlapping en-echelon branches of the major bounding faults is deformed and rotated by a system of subparallel faults oriented nearly orthogonal to the major master faults. Clockwise rotation of the individual block slices can then accommodate right-lateral shear across the major NW-striking faults even when these master faults are locked. This model accounts for several geologic features associated with Coyote Ridge including the timing and ages of various faults, the uplift, the amounts of slip and the amounts of rotation involved. Other cases where this model may be applicable include Parkfield and the deformation associated with the Coyote Lake earthquake on the Calaveras fault.

S22A-12

Recent Seismicity (1970-1984) Along the Newport-Inglewood Fault, Los Angeles Basin, Southern California

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A total of 32 earthquakes ($3.0 < M_L < 4.0$) have occurred in or near the Newport-Inglewood fault zone (N-IFZ) in the Los Angeles Basin from 1970 to August 1984. No earthquakes of $M_L > 4.0$ have occurred near the N-IFZ since 1961. The recent seismicity is distributed evenly along the 60 km length of the N-IFZ (from the Santa Monica Mountains in the north to Newport Beach in the south) except for a high concentration of seismic activity observed in the Baldwin Hills region near the northern end of the fault zone. The depth distribution ranges from 5 to 15 km. Single event fault plane solution of 20 of these earthquakes indicate a mixture of thrusting and right-lateral strike-slip motion along the N-IFZ. The axis of maximum compression is subhorizontal and the azimuth ranges from N0°E to approximately N30°E, which is consistent with the regional compressive stress field observed in the western Transverse Ranges in southern California.

S22A-13

Reevaluation of the 1892 Winters, California Earthquakes Based Upon a Comparison with the 1983 Coalinga Earthquake

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On 19 and 21 April 1892, two large earthquakes occurred in the vicinity of Winters and Vacaville, California. Both events were felt over a widespread area exceeding 200,000 km^2 and extending into Nevada. Both produced maximum MM intensities of IX. Isoseismal maps produced by Dale (1977) and Toppozada