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## Imaging the Deep Structure of the Central Death Valley Basin Using Receiver Function, Gravity, and Magnetic Data

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### Author(s)

Musa Hussein, Laura Serpa, Diane Doser, Aaron Velasco

### ABSTRACT

We use receiver function, gravity, and magnetic data to image the deep structures of central Death Valley. Receiver function analysis suggests the Moho is 24 km deep in the central part of the basin and deepens to 33 km to the east and 31 km to the west. The estimated lower crustal density is 2900 kg/m<sup>3</sup>, which suggests a gabbroic composition, whereas the upper crustal density, excluding basin sediments, is estimated to average 2690 kg/m<sup>3</sup> or approximately a quartzofeldspathic composition. We modeled the magnetic sources as upper crustal to suggest a relatively shallow Curie depth in this region of high heat flow. We developed models to test the hypothesis that a low-density, non-magnetic body (magma or fluid-rich material?) within the lower crust at a depth of 15 km could coincide with the location of the Death Valley bright spot imaged on a deep seismic reflection profile. Those models suggest that if there is a low density region in the mid to lower crust in the area of the bright spot, then the region is also likely to be underplated by mafic or ultramafic materials which may have contributed to heating, uplift, and thinning of the crust during extension.

### KEYWORDS

Bright Spot, Crustal Models, Data Incorporation, Death Valley, Magmatic Underplating

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### References

- [1] L. Serpa and B. deVoogd, " Deep Seismic Reflection Evidence for the Role of Extension in the Evolution of Continental Crust," *Royal Association Society Geophysical Journal*, Vol. 89, No. 1, 1987, pp. 55-60.
- [2] L. Serpa, B. de Voogd, L. Wright, J. Willemin, J. Oliver, E. Hauser and B. Troxel, " Structure of the Central Death Valley Pull apart Basin and Vicinity from the COCORP Models in the Southern Great Basin," *Geological Society of America Bulletin*, Vol. 100, No. 9, 1988, pp. 1437- 1450. doi:10.1130/0016-7606(1988)100<1437:SOTCDV>2.3.CO;2
- [3] J. Snow and B. Wernicke, " Uniqueness of Geologic Correlation: An Example from the Death Valley Extended Terrain," *Geological Society of America Bulletin*, Vol. 101, No. 11, 1989, pp. 876-885.
- [4] L. Serpa and T. Pavlis, " Three-Dimensional Model of the Late Cenozoic History of the Death Valley Region, South-Eastern California," *Tectonics*, Vol. 15, 1996, pp. 1113-1128. doi:10.1029/96TC01633
- [5] L. Wright, R. Greene, I. Cemen, F. Johnson, A. Prave and R. Drake, " Tectonostratigraphic Development of the Miocene-Pliocene Furnace Creek Basin and Related Features, Death Valley Region, California," In: L. Wright and B. Troxel, Eds., *Cenozoic Basins of the Death Valley Region*, Geological Society of America Special Paper 333, 1996, pp. 115-126.
- [6] G. Miller, " Basement-Involved Thrust Faulting in a Thin-Skinned Fold-and-Thrust Belt, Death Valley, California, USA," *Geology*, Vol. 31, No. 1, 2003, pp. 31-34. doi:10.1130/0091-7613(2003)

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- [7] M. Miller and T. Pavlis, "The Black Mountains Turtle-backs: Rosetta Stones of Death Valley Tectonics," *Earth Science Reviews*, Vol. 73, No. 1-4, 2005, pp. 115-138. doi: 10.1016/j.earscirev.2005.04.007
- [8] B. de Voogd, L. Serpa, L. Brown, E. Hauser, S. Kaufman, J. Oliver, B. Troxel, B. Willemin and L. Wright, "The Death Valley Bright Spot; A Midcrustal Magma Body in the Southern Great Basin, California," *Geology*, Vol. 14, No. 1, 1986, pp. 64-67. doi: 10.1130/0091-7613(1986)14<64:DVBSAM>2.0.CO;2
- [9] T. Brocher, P. Hart and S. Carle, "Feasibility Study of the Seismic Reflection Method in Armargosa Desert, Nye County, Nevada," U.S. Geological Survey Open-File Report, 1990, pp. 89-133.
- [10] S. Park, "Mantle Heterogeneity beneath Eastern California from Magnetotelluric Measurements," *Journal of Geophysical Research*, Vol. 109, No. B09406, 2004, pp. 1-13. doi: 10.1029/2003JB002948
- [11] S. Park and B. Wernicke, "Electrical Conductivity Image of Quaternary Faults and Tertiary Detachments in the California Basin and Range," *Tectonics*, Vol. 22, No. 4, 2003, pp. 1-17. doi: 10.1029/2001TC001324
- [12] J. Louie, S. Pullammanappallil and W. Honjas, "Velocity Models for the Highly Extended Crust of the Death Valley, California," *Geophysical Research Letters*, Vol. 24, No. 7, 1997, pp. 735-738. doi: 10.1029/97GL00574
- [13] B. Burchfiel and J. Stewart, "Pull-Apart Origin of the Central Segment of the Death Valley, California," *Geological Society of America Bulletin*, Vol. 77, No. 4, 1966, pp. 439-442. doi: 10.1130/0016-7606(1966)77[439:POOTCS]2.0.CO;2
- [14] C. Keener, L. Serpa and T. Pavlis, "Faulting at Mormon point, Death Valley, California: A Low-Angle Normal Fault Cut by a High-Angle Fault," *Geology*, Vol. 21, No. 4, 1993, pp. 327-330. doi: 10.1130/0091-7613(1993)021<0327:FAMPDV>2.3.CO;2
- [15] L. Wright and B. Troxel, "Shallow-Fault Interpretation of Basin and Range Structure Southwestern Great Basin," In: K. A. DeJon and R. Scholten, Eds., *Gravity and Tectonics*, John Wiley and Sons, New York, 1973, pp. 397-407.
- [16] Z. Sylvester, "Facies, Architecture and Bed-Thickness Structure of Turbidity Systems: Examples from the East Carpathian Flysch, Romania, and the Great Valley Group, California," Ph.D. Dissertation, Stanford University, Stanford, 2001.
- [17] C. Hunt and D. Mabey, "Stratigraphy and Structure, Death Valley California," US Geological Survey Professional Paper 494-A, U.S. Government Printing Office Washington, DC, 1966.
- [18] E. Geist and T. Brocher, "Geometry and Subsurface Lithology of Southern Death Valley Basin, California, Based on Refraction Analysis of Multichannel Seismic Data," *Geology*, Vol. 15, No. 12, 1987, pp. 1159-1162. doi: 10.1130/0091-7613(1987)15<1159:GASLOS>2.0.CO;2
- [19] R. Blakely, R. Jachens, J. Calzia and V. Langenheim, "Cenozoic Basins of the Death Valley Extended Terrane as Reflected in Regional-Scale Gravity Anomalies," In: L.A. Wright and B. W. Troxel, Eds., *Cenozoic Basins of the Death Valley Region*, Geological Society of America Special Paper, Boulder, Vol. 333, 1999, pp. 1-16.
- [20] L. Serpa, "The Three Dimensional Geometry of the Garlock Fault Zone," *Geological Society of America Abstract with Programs*, Vol. 19, 1987, p. 838.
- [21] B. deVoogd, L. Serpa and L. Brown, "Crustal Extension and Magmatic Processes: COCORP Profiles from Death Valley and the Rio Grande Rift," *Geological Society of America Bulletin*, Vol. 100, No. 10, 1988, pp. 1550-1567. doi: 10.1130/0016-7606(1988)100<1550:CEAMPC>2.3.CO;2
- [22] L. Serpa, "Structural Styles Across an Extensional Orogen; Results from the COCORP Mojave and Death Valley Seismic Transects," In: B. P. Wernicke, Ed., *Basin and Range Extensional Tectonics near the Latitude of Las Vegas, Nevada*, Geological Society of America Memoir 176, Boulder, 1990, pp. 335-344.
- [23] F. O' Doherty and A. Anstey, "Reflections on Amplitudes," *Geophysical Prospecting*, Vol. 19, No. 3, 1971, pp. 430-458. doi: 10.1111/j.1365-2478.1971.tb00610.x
- [24] W. Ewing, W. Jardetsky and F. Press "Elastic Waves in Layered Media," McGraw-Hill, New York, 1957, p. 380.

- [25] B. Crowe, S. Self, D. Vaniman, R. Amos and F. Perry, "Aspects of Potential Magmatic Disruption of a High Level Radioactive Waste Repository in Southern Nevada," *Journal of Geology*, Vol. 91, No. 3, 1983, pp. 259-276. doi:10.1086/628770
- [26] C. Herzberg, W. Fyfe and M. Carr, "Density Constraints on the Formation of the Continental Moho and Crust," *Contributions to Mineralogy and Petrology*, Vol. 84, No. 1, 1983, pp. 1-5. doi:10.1007/BF01132324
- [27] C. Ammon, G. Randall and G. Zandt, "On the Nonuniqueness of Receiver Function Inversions," *Journal of Geophysical Research*, Vol. 95, No. B10, 1990, pp. 15303-15318. doi:10.1029/JB095iB10p15303
- [28] L. Zhu and H. Kanamori, "Moho Depth Variation in Southern California from Teleseismic Receiver Functions," *Journal of Geophysical Research*, Vol. 105, No. B2, 2000, pp. 2969-2980. doi:10.1029/1999JB900322
- [29] J. Ligorria and C. Ammon, "Iterative Deconvolution and Receiver Function Estimation," *Bulletin of Seismological Society of America*, Vol. 89, No. 5, 1999, pp. 1395-1400.
- [30] L. Zhu, "Estimation of Crustal Thickness and Vp/Vs Ratio beneath the Tibetan Plateau from Teleseismic Converted Waves," *EOS Transactions of AGU*, Vol. 74 No. 16, 1993.
- [31] G. Zandt, S. Myers and T. Wallace, "Crust and Mantle Structure across the Basin and Range Colorado Plateau boundary at 37° N Latitude and Implication for Cenozoic Extensional Mechanism," *Journal of Geophysical Research*, Vol. 100, No. B6, 1995, pp. 10529-10548. doi:10.1029/94JB03063
- [32] G. Zandt and C. Ammon, "Continental Crust Composition Constrained by Measurements of Crustal Poisson Ratio," *Nature*, Vol. 374, 1995, pp. 152-154. doi:10.1038/374152a0
- [33] D. Eaton, S. Dineva and R. Mereu, "Crustal Thickness and Vp/Vs Variations in the Grenville Orogen (Ontario, Canada) from Analysis of Teleseismic Receiver Functions," *Tectonophysics*, Vol. 420, No. 1-2, 2006, pp. 223-238. doi:10.1016/j.tecto.2006.01.023
- [34] T. Nakajima, A. Matsuzawa, A. Hasegawa and D. Zaho, "Three Dimensional Structure of Vp, Vs and Vp/Vs beneath Northeastern Japan: Implications for Arc Magmatism and Fluids," *Journal of Geophysical Research*, Vol. 106, No. B10, 2001, pp. 21843-21857. doi:10.1029/2000JB000008
- [35] W. Webring, "MINC, a Gridding Program Based on Minimum Curvature," U.S. Geological Survey Open-File Report, U.S. Geological Survey, Denver, 1982, pp. 81-1224,
- [36] D. Plouff, "Preliminary Documentation for a FORTRAN Program to Compute Gravity Terrain Corrections Based on Topography Digitized on a Geographic Grid," U.S. Geological Survey Open File Report, U.S. Geological Survey, Denver, 1977, pp. 77-535.
- [37] V. Bankey, A. Cuevas, D. Daniels, C. Finn, I. Hernandez, P. Hill, R. Kucks, W. Miles, M. Pilkington, C. Roberts, W. Roest, V. Rystrom, S. Shearer, S. Snyder, R. Sweeney, J. Velez, J. Phillips and D. Ravat, D. "Digital Data Grids for the magnetic Anomaly187 Map of North America," U.S. Geological Survey Open-File Report 02-414, U.S. Geological Survey, Denver, 2002.