INTEGRATING GEOLOGICAL AND GEOPHYSICAL CONSTRAINTS TO STUDY CRUST AND MANTLE PROCESSES

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Questions to be addressed:

1) What are the breakthrough results from ES so far and how do they inform goals for future work?

1. Imaging the Yellowstone plume from 1000 km to surface.
2. Discovery of lower-crustal anisotropy with crustal thinning.
3. Geochemical correlation of magma origins with redite/ "orange-ite"
4. Real-time imaging of delamination drip of Sierra Nevada – xenolith story as calibration
5. Great Basin mantle anomaly and what is its surface expression.
6. Imaging double slab in Pacific Northwest
7. SKS anisotropy in western US showing interpreted toroidal motions
8. Down-dip change in velocity signature of Juan de Fuca slab, beneath the arc
9. ETS—unexpected discovery
10. Geochemical signature of history of delamination in the Sierras
11. EM creates the first 3D pictures of high conductivity lower crust that correlate with styles of deformation
12. Vertical anomalies in the mantle (imaged by tomography) vs horizontal anomalies (LAB, MLD, imaged by converted/scattered waves) should be rationalized.

2) What are the key scientific questions and opportunities for the ES program over the next 5-10 yrs?

1. Does lithospheric complexity persist as the TA moves east of the Rockies?

2. Mantle: How long are heterogeneities preserved in mantle? Are red-ites and blue-ites chemical, thermal and/or anisotropic heterogeneities in mantle?

3. How do we interpret seismic velocity—composition, temperature, fluid presence, anisotropy? For example, do the observed drip-like velocity anomalies represent compositional, thermal, fluid-laced, or anisotropic bodies

4. What is a craton and how does it form? How defined seismologically or geochemically. How are cratons created and destroyed? How to lose a cratonic root? What is anorogenic magmatism and what role does it play in cratonization?

5. Can geochemistry tell us what kind/age of lithosphere is below a given region of crust?

6. What is the nature of crust/mantle or lithosphere/asthenosphere interactions/exchange.

7. What is the nature of the Moho? What do we know about the Moho? What is it and how do we constrain?

8. What is the nature and composition of lower crust and its role in the evolution of the continent.

9. What are the origins of intra-continental basins, arches, and domes? Why did they form? Why are they persistent?

10. What is the structure and composition of the crust across the U.S.? We need a picture of this to match and to be able to interpret the picture of the mantle that we will get from TA.

11. What are the differences in crust formation/evolution and plate tectonics in Archean vs post-Archean times?

12. What were the magmatic contributions to crust and mantle in rift zones and other settings; continental accretion processes don't occur only at arcs.

13. What is the role of a pre-exsiting structure in deformation? Why do these localize deformation in some cases and other cases not.

Finally: In order to discuss continental evolution you need to start at the beginning. What was the nature of the oldest crust; how and when was it formed; how much has been destroyed; how much is left; what record is preserved in the underlying lithospheric mantle.

3) How can the strengths of different disciplines be most effectively combined to meet future science goals?

Different disciplines (potential scientific partners) are:

Seismology—passive and active—emphasis of ES so far
Geodesy/strain—also emphasis of ES
Geology
Geochemistry
Geochronology
Mineral physics
Geodynamic modeling
Potential-field geophysics (gravity, mag)
MT

1) Different models for ES
    Problem focus
    Site focus
    CD model for interdisciplinary problem and/or site focus

2) Requiring that proposals of widely disparate size face the same panel is a problem. Separate.

3) Oil companies have a well organized model for integrating all types of data. This is currently difficult for the academic community. Infrastructure, $$ required.

4) Complex data sets need integration--cyberinfrastucture

5) Small workshops would help in writing large integrative proposals

6) Earthscope integrate: Small (~$5K) workshops to integrate data from ES projects.

7) GeoSwath is a focus site. So is PBO.

8) An effective way to combine the strengths of seismology and geology is to collect crustal-scale seismic reflection data. This provides interfaces that can be related to dated geological structures. This crustal-scale imaging is expensive but supplies answers that cannot be gotten any other way on how mantle features relate to surface.