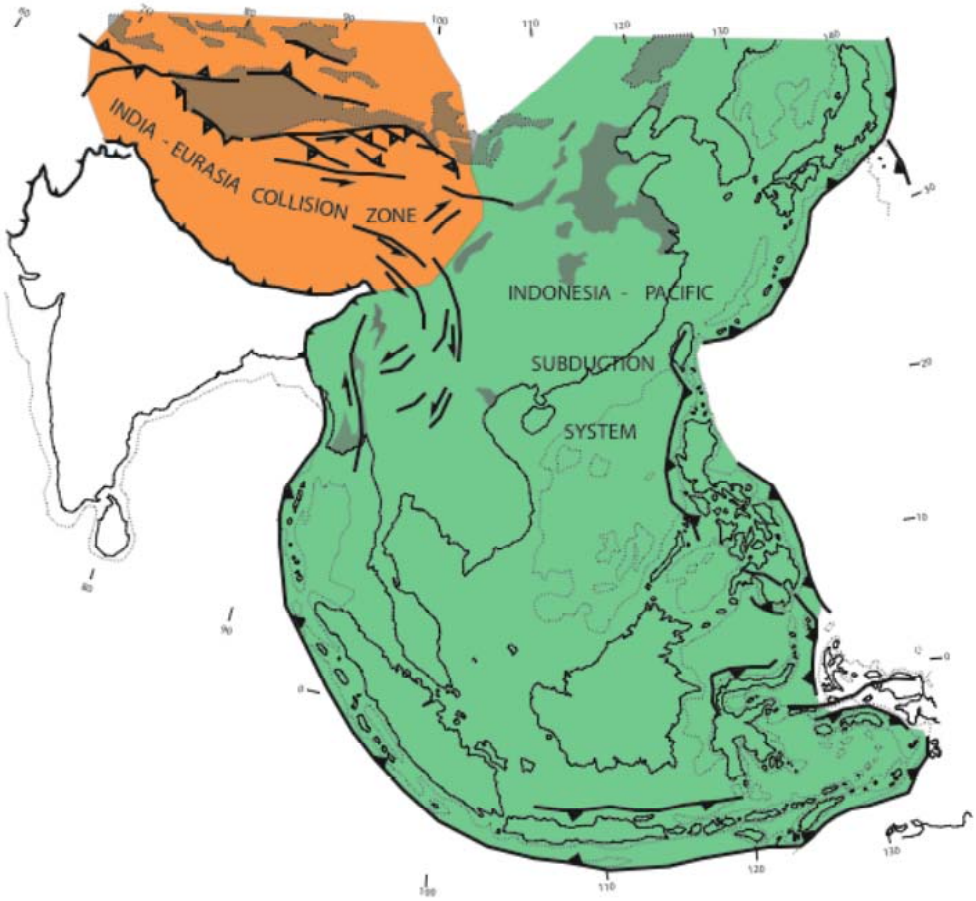
Relations between upper crustal geology and lithosphere/asthenosphere and deeper mantle structure

B. Clark Burchfiel
Department of Earth, Atmospheric and Planetary Sciences
Massachusetts Institute of Technology
Cambridge, MA, 02139
USA

Crustal structure can be well determined, but within and below the lower crust knowledge of structure and dynamic processes become increasingly less well known. We must rely on remote sensing techniques for an understanding of how directly structures in the crust are related to deeper subcrustal structure. The tectonics of southeast Asia provide a wide variety of data that suggest that: 1) Decoupling of the crustal and deeper subcrustal structure occurs to varying degrees, 2) Subduction along the Himalaya is laterally variable within the mantle even though Himalayan crustal structure appears reasonably continuous, 3) Early Cenozoic crustal tectonics of southeast Asia is controlled by two large dynamic systems: India/Eurasia collision and West Pacific/Indonesian subduction, 4) These two systems have interacted to cause major early Cenozoic SE extrusion of crustal/lithospheric fragments, 5) Large scale variations in mantle velocities to depths of a few hundred kilometers can sometimes be correlated with surface and crustal features, but many cannot, and 6) Cenozoic roll back in West Pacific/Indonesian subduction system, in the Indonesian region, appears to extend to more than 1000 km indicating significant mass movement of deeper mantle, and may be decoupled from smaller scale subduction and possible convection at shallower levels. As a new a hypothesize we are currently investigating that extrusion modified the upper mantle to leave a track in the direction of extrusion of thinned lithosphere forming a belt of alkalic magmatism that extends from central Tibet into Indochina.

Because the motions of material in SE Asia have been large and rapid it provides an example of processes that might be applied to other areas such as the Mediterranean region. As an example decoupling of structure between upper crustal and deeper rocks is known from the Alpine system, but lateral variations remain to be worked out. Whether the decoupling can be related to lower crustal flow as in some parts of SE Asia remains unclear. Extrusion of crustal/lithospheric fragments are well known in several parts of the Alpine system and are probably better related to the interactions of two dynamic systems than SE Asia, but whether they produced volcanic tracks as suggested for SE Asia remains to be examined. Subduction of lithosphere to deep mantle levels is supported by evidence from the eastern Mediterranean, as well as from SE Asia, but whether smaller scale shallow subduction and convection also occurs is needs to be examined. How such mantle movements relate to upper crustal structure remains unclear.

As yet it is difficult, except in rare cases, to relate variations in mantle velocities to mantle kinematics, dynamics and the geology of the in the shallow crust. This is a field for fertile research, but we have a long way to go.



GENERALIZED TECTONIC FRAMEWORK OF SOUTHEAST ASIA