Deep seismic: a new exploration tool

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Seismic reflection studies of the deep continental crust provide new and startling views of the nature and physical behaviour of this region which controls sedimentary basin development. Unexpected layering in the deep crust provides a horizon for detachment of dipping shear zones which approach the lower crust from either the upper crust or the mantle. Some shear zones appear to cut through the whole crust and some clearly offset the Moho. Clear evidence of repeated movement on earlier compressional structures reactivated in extension (e.g., Viking Graben, Jeanne d'Arc Basin) is recognized. Some zones lacking obvious extensional faulting have associated dipping shears. The depth to detachment of faults in extension, whether shallow in the deep crust, or lower in the mantle, has significant bearing on basin formation, and on thermal maturation.

In compressional regimes, foreland propagating thrusts are often "blind" and deeply penetrating, and may be responsible for structures well away from the supposed deformation front. Models of Appalachian foreland thrusts permit comparisons with Rocky Mountain features flanking the Alberta Basin.

Deep seismic has much to offer for understanding the history and internal structure of basins. Recording to 15 or more seconds should become routine in basin exploration, especially in reconnaissance. Reconsideration of in-house data can be significant for appreciation of deep structure.

Such results, in conjunction with fluid and sedimentary facies basin analysis, provide exciting insight for definition of new exploration targets. This research, underway at the Centre for Earth Resources Research (CERR), utilizes a newly acquired CONVEX minisupercomputer funded by Petro-Canada and NSERC.