

A STORY OF BANANAS AND DOUGHNUTS

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Tony Dahlen made his early marks in low-frequency seismology, but the last ten years his attention shifted towards the interpretation of P and S arrivals, body waves of much higher frequency. In this talk I will tell some of the early history of how the Princeton seismology group stumbled upon banana-shaped sensitivity kernels for body waves and had long discussions on the paradoxes posed by the doughnut-like hole.

Tony's paraxial theory allowed us to incorporate the banana-doughnut kernels into seismic tomography. Raffaella Montelli's discovery of plumes in the lower mantle, below many known hotspots such as Tahiti, cast the method of 'finite-frequency tomography' into the heated debate on the existence of mantle plumes, and confused an already garbled debate on the theoretical validity of the banana-doughnut kernels.

By now the debate seems to have largely subsided. Banana-doughnut kernels are accepted and finding their way into everyday practice. The observed lower mantle plumes are substantial in size and force us to reconsider accepted notions about how the Earth is cooling. They may even lead to reconcile geochemical observations that seem to require a two-layered convective system, with tomographic observations of slabs subducting below the 670 discontinuity and geophysical theory, both of which favour mass exchange between upper and lower mantle.