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Book Review

Arrays and Array Methods in Global Seismology, by Yu Jeffrey Gu (ed), Springer, 2010; ISBN: 978-90-481-3679-7

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The implementation of high-quality seismic arrays over the past 10 years (e.g., the high-sensitivity seismograph network in Japan and the Transportable Array in the United States) has made it possible to utilize imaging techniques, originally developed for exploration seismology, on a global scale. *Arrays and Array Methods in Global Seismology* gives a review of these techniques, as well as how they have been applied to image the structure of the crust and mantle. This review is presented as a series of manuscripts from experts in specific fields. In addition to basic theory, many of the chapters include brief descriptions of processing steps that should motivate potential researchers. This style is ideal for beginning graduate students, as sufficient information is given to begin a project using these methods, while keeping the content light enough for those readers who only want an overview of array analysis.

The topics presented in this book fall into two categories: those that are fundamentally dependent on the use of array data and the methods developed in exploration seismology (e.g., imaging scatterers using migration), and those for which array data can be used to improve resolution, but are not necessary for these studies to be performed (e.g., surface wave tomography). While papers in both categories provide intriguing discussion, I suspect the former is what readers may expect given the title of the book.

The book begins with an overview by Sebastian Rost and Christine Thomas on some of the common techniques used for processing array data. The descriptions of these techniques are clearly stated and should be useful for any interested researcher. One particular focus is time-shifting and stacking array data for signal enhancement (e.g., slant stacking). This is followed by a discussion of the resolution issues that arise when using such methods. This work concludes with an example where scatterers within the mantle are located using the principles of migration.

Arwen Deuss describes the imaging of mantle discontinuities using normal move out techniques with PP and SS precursors in the next manuscript. Much of the discussion in this work is based upon observations obtained in previous studies. In particular, there is attention paid to the topography and thickness of the transition zone. These observations are supplemented by a discussion on interpretations based upon results in the mineral physics and geodynamics communities.

Radon transforms are introduced by Yu Jeffrey Gu and Mauricio Sacchi as an alternative method for imaging mantle discontinuities. There is a brief discussion on the different Radon transforms (i.e., linear, parabolic, and hyperbolic), and the appropriate conditions for the application of each approach. The more advanced Radon transform inversions are also introduced with a demonstration of the resolution improvements that can be achieved when imaging mantle discontinuities.

Yi Wang, Lianxing Wen, and Donald Weidner discuss the use of triplication phases to determine the structure of the upper mantle. This work begins with a short description of the common phases that are produced from wave interaction with the structure of

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the upper mantle. This is followed by qualitative examples of how information about crossover distances and distance/amplitude relationships of the different phases can be used to determine the properties of the upper mantle, such as velocity jumps and gradients. In addition, there is a short section on the implications of the resulting velocity profiles for the dynamics and composition of the mantle.

The procedure for imaging the crust and upper mantle with converted and scattered waves is presented by Stéphane Rondenay. The highlights of this chapter are the sections on data preprocessing and the generation of receiver functions. The clarity of these sections will help to motivate and guide any person interested in pursuing similar imaging studies. These sections are followed by a general overview of the moveout and migration methods needed to image conversion and scatter locations, respectively. The imaging capability of these techniques is well illustrated with some interesting examples from the Alaska subduction zone.

Shear wave splitting and its relationship to mantle anisotropy is the focus of the work presented by Maureen D. Long and Paul G. Silver. A large portion of the chapter is devoted to the different approaches of measuring shear wave splitting. This is followed by a discussion of the seismic phases used to characterize anisotropy at different depths in the mantle. There is also a short section on the methods used to model the shear wave splitting measurements that includes shear wave splitting tomography. As with the previous chapters, the final sections are devoted to inferring mantle processes. This includes discussions on mantle flow beneath ocean basins, continental regions, mid-ocean ridges, and subduction zones.

In the next manuscript, Lapo Boschi, Bill Fry, Göran Ekström, and Domenico Giardini derive a global three-dimensional tomographic model using Love- and Rayleigh-waves. The main connection between this chapter and the theme of the book is a discussion on the improvements to resolution that can be obtained from broadband stations from the Swiss and German seismic networks.

The final manuscript by Roel Snieder, Masatoshi Miyazawa, Evert Slob, Ivan Vasconcelos, and Kees Wapenaar is devoted to seismic interferometry. There are brief introductions to three approaches commonly used with this method (correlation, deconvolution, and multidimensional deconvolution). This section concludes with a helpful table on the advantages and disadvantages of each approach. In addition, an example from an imaged salt body illustrates the resolution differences between correlation and deconvolution.

Arrays and Array Methods in Global Seismology is an excellent resource for anyone interested in array analysis. Many of the manuscripts are written in a practical way such that the reader can immediately use the techniques in their own research. One possible weakness is the lack of discussion of source studies that utilize array data. However, the preface suggests that this may be the focus of a future book. Given the increase in the number of dense arrays that have been deployed in recent years, this book is a timely resource for the growing number of researchers who wish to utilize this data.