BOOK REVIEW

Seismic Reflection Processing With Special Reference to Anisotropy

S. K. Upadhyay
Springer-Verlag; ISBN 3-540-40875-4; xviii + 636 pp.; 2004; $119.00

PAGE 436

Seismic reflection data are used extensively in petroleum exploration and development to provide subsurface images and estimates of rock and fluid properties. Data acquisition, processing, and interpretation methodologies have progressed over the past 30 years to allow high-resolution three-dimensional imaging, pore fluid and lithology prediction, and, in certain situations, time-lapse monitoring of reservoir production. Exploration seismology experiences and applications are also finding their way into whole-Earth imaging problems (and vice versa) with great success.

Into this long and successful history, S. K. Upadhyay's book, *Seismic Reflection Processing With Special Reference to Anisotropy*, is introduced.

The book tackles important issues surrounding seismic anisotropy, or the observation that seismic waves propagate with different speeds in different directions, depending on the properties of the crust. These issues involve accounting for anisotropy in practical applications, such as imaging and in estimating of rock properties, as well as measuring such anisotropy as an | important parameter in its own right. Anisotropy is the rule rather than the exception in the Earth, whether it is caused by aligned fractures, mineralogical or lithological fabric, or an inhomogeneous stress field. If this effect is not accounted for, then subsurface images and estimations will be inaccurate and incomplete. These problems have been well understood and well studied in the literature.

In some applications, the accurate measurement of the anisotropy itself provides important information. For example, studying seismic anisotropy can be used to characterize the orientation of buried fractures and faults, as well as spatial variations in the degree of fracturing.

This book not only attempts to cover these important issues in anisotropy, but also strives to provide introductory material in seismic acquisition, processing, imaging, and analysis. Such an undertaking seems overly ambitious but, in this book, it is generally quite successful. The book covers the full spectrum of topics, from a review of seismic reflection data acquisition, standard processing methods, velocity analysis, amplitude variations with offset (AVO) interpretation, and migration, through a detailed discussion of the effects of anisotropy on each of these topics.

In particular, Upadhyay focuses on fracture-induced anisotropy and transversely isotropic media (materials where wave speed on one geometric plane is the same but differs from wave speed on a perpendicular plane).

The book is a good resource that reviews and presents a substantial collection of the methods and approaches developed in the literature. The book covers many of the seismic topics in Dobrin's book, *Introduction to Geophysical Prospecting*, and also provides summary chapters on the major topics in Yilmaz's book, *Seismic Processing*. With that said, it is quite surprising that Yilmaz's book (considered by many to be the definitive reference for seismic data processing) was not even referenced by Upadhyay.

In the early sections of Upadhyay's book, the references are quite dated (most are from the 1970s and 1980s). However, in later chapters that deal with topics in anisotropy and fracture analysis, the references are more complete.

Although the book does not present a lot of original material, it does cover a lot of ground quickly and provides excellent summaries of many important topics in seismic processing, imaging, and analysis. It also provides good derivations of some important concepts (such as velocity analysis in transversely isotropic media, AVO interpretation, and migration). As a textbook, it has the added feature of occasional exercises and their solutions.

This book is a welcome addition to the reference library of an advanced graduate student or a practicing exploration seismologist. This book would also serve as a good reference for scientists in other fields who are looking for a concise overview of reflection seismology.

—DAN BURNS, Earth Resources Laboratory, Massachusetts Institute of Technology, Cambridge.

In Brief

PAGE 430

U.S. Navy Sued Over Sonar Use The Natural Resources Defense Council and other environment groups on 19 October filed a federal lawsuit in Los Angeles against the U.S. Navy over its use of mid-frequency sonar, the principle system used aboard U.S. naval vessels to locate submarines and underwater objects.

This sonar operates around the three kilohertz range. The lawsuit alleges that mid-frequency sonar harms marine mammals and violates environmental laws, including the Marine Mammals Protection Act. NRDC lawyer Andrew Wetzler said the goal of this suit is to compel the Navy to use commonsense measures to avoid harming marine species.

The Navy claims that this lawsuit could weaken national security. William Marks, a Navy spokesperson on environmental issues, said the Navy has developed and implemented a strategy to assess potential effects of its use of mid-frequency sonar on marine mammals. "We employ scientifically-based protective measures as part of that strategy," he said. These measures involve restricting training locations, surveying for marine mammals that cross ships' paths, and ceasing operations if the animals come within 200 yards of active sonar transmissions.

The lawsuit is not directed against marine geological or geophysical research, which employs sonar devises and air gun pulses to study the structures on and within the ocean floor. Alexander Shor, a geophysicist in the Division of Ocean Sciences at the U.S. National Science Foundation, noted that geophysical sub-bottom and mulitbeam profilers do operate on frequencies comparable or greater than the Navy's. "But these are pulsed, pointed downward, and are nowhere near as loud," he said. By contrast, the Navy's sonar is a sustained tone that propagates horizontally through the ocean.

Nevertheless, Shor is concerned that undersea noise used in geophysical studies might be singled out in the future, delaying or even preventing science research. "Already, lawsuits and the permitting process slow things down," Shor said.

This case follows a successful lawsuit two years ago against global deployment of the Navy's low-frequency active sonar system. Pulses from air gun arrays, which resonate at around 100 hertz, came under scrutiny in 2002 after whales were reported to have beached themselves following geophysical tests conducted on Columbia University's R/V *Ewing*.

—MOHI KUMAR, Staff Writer