

Hot topics in geophysics: Progress, trends, and perspectives

Tobi Ore¹, Eileen R. Martin^{1,2}, Igor Rubio-Cisneros³, Aaron Girard⁴, Joseph Ma⁵, Shriya Kanakiyar⁶, Oluseun Samuade⁷, Aleksei Titov⁸, and Rafael de Souza⁹

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Introduction

Over the past decade, computing power has increased, new sensing technologies have been developed, and our understanding of how we interact with the earth has evolved, leading to new opportunities and priorities in geophysical research. These changes have been more rapid in some areas than others, and new topics have emerged as well. It is challenging for geophysicists, including junior staff and undergraduates starting their geophysics journeys, to stay abreast of scientific and industrial trends. Thus, the Early Career Subcommittee of the SEG Research Committee (RC) thought it imperative to survey members of the RC in 2022. To that end, a survey was conducted, and responses were collected from 43 RC members.

Inspired by a similar 2012 survey, the goals of this 2022 survey were to (1) gain perspective on the recent evolution and current state of applied geophysics, (2) highlight opportunities for SEG to support member interests in key emerging research topics, and (3) summarize current priorities in academic and industrial research for the SEG community, particularly early-career members. The nonexhaustive list of 26 topics in this survey is intended to represent a wide swath of geophysical applications and techniques. All topics were evaluated on their level of maturity, importance to current and future needs, ability to address long-standing challenges, and excitement or interest level. While this survey has its limitations, it does capture a distinctive, valuable snapshot of contemporary geophysics research interests.

Survey design

The information presented in this article comes from 2022 and 2012 SEG RC survey responses. The Early Career Subcommittee compiled a preliminary list of 26 topics with input from the RC. The historical data come from the RC's report on a similar survey

conducted in 2012. In addition to serving as a gauge of advances in these topics, this work puts 10 years of new research directions into context.

The survey was completed anonymously by RC members, who are subject-matter experts in academia, industry, and government organizations. The 26 research areas spanned methods and applications (Table 1). The survey was designed to obtain rankings on a scale of 1 to 5 and free responses to the following questions:

- How mature or well-developed is the area? (from [1] incremental developments needed for application to [5] large foundational advances needed)
- How important is the research area to the respondent's (or respondent organization's) current needs? (from [1] not important to [5] very important)
- How important is the research area to the respondent's (or respondent organization's) future needs? (from [1] not important to [5] very important)

Table 1. Select research topics categorized as methods and applications.

Methods	Applications
Ambient/passive seismic	Carbon capture, utilization, and storage
Autonomous/low-cost data acquisition	Engineering geophysics
Bayesian inversion	Environmental geophysics
Benthic geophysics	Ecologic/geophysical hazards
Digital rock physics	Geothermal exploration and production
Distributed fiber-optic sensing	Humanitarian applications of geophysics
Electromagnetics	Mining geophysics
Full waveform inversion	Reservoir monitoring
Gravity	Smart cities/urban geophysics
High-performance computing	Space geophysics (exo-planetary)
Induced seismicity and microseismic	Discovered assets
Low-frequency acquisition	
Machine learning and artificial intelligence	
Multiphysics inversion	
Potential fields	

¹West Virginia University, Department of Geology and Geography, Morgantown, West Virginia, USA.

²Colorado School of Mines, Department of Geophysics, Golden, Colorado, USA.

³Colorado School of Mines, Department of Applied Math and Statistics, Golden, Colorado, USA.

⁴Toed Geociencias e Engenharia Aplicada, Nuevo Leon, Mexico.

⁵Halliburton Far East Pte. Ltd., Singapore.

⁶University of Houston, Houston, Texas, USA.

⁷Oklahoma State University, Boone Pickens School of Geology, Stillwater, Oklahoma, USA.

⁸Fervo Energy, Houston, Texas, USA.

⁹Avanade Australia, Perth, Western Australia, Australia.

Topics In Geophysics

Florida International University



Topics In Geophysics:

Topics in Geophysics Peter J. Smith, 1973-01 Exploration beyond the Earth has tended to overshadow the less spectacular but no less far reaching and significant efforts to understand our home planet efforts that have in recent years produced massive quantities of new data and beyond that a radically new way of looking at the Earth a new worldview a Whole Earth approach a global concept As a result it no longer suffices to update older texts with a scattering of new facts or to write new ones based on older models This genuinely new text prepared by the chairman of the geophysics course team at England's Open University bases itself firmly but undogmatically on these new discoveries in particular on knowledge of the large scale features of the Earth's surface and interior in both their static and dynamic contexts This is the global picture of the Earth as perceived by today's Earth scientist although it carries with it no implication that will necessarily stand for all time without change or even without radical change The book opens with a general chapter summarizing this global picture which is followed by three topics chapters carefully designed to present three different aspects of geophysics and three different approaches to the science Among them they explore the Earth's crust mantle and core but Smith has chosen to examine a few aspects in some detail rather than treat many in passing This in a sense is a case study text it is meant for undergraduates and only simple mathematics is called upon The first topic is The Earth's Crust and Uppermost Mantle This typifies the observational branch of geophysics and draws its conclusions from experimental evidence supported by a broad data base The second treats The Earth's Heat and Thermal Properties a subject that Smith calls the most important of all branches of geophysics Nevertheless the material presented here is not well covered in most texts at least in part because it represents a speculative approach to geophysics in the sense that processes that occur deep within the Earth must be inferred from very few clear data and they may be interpreted in quite different ways The last topic is Earthquakes Characteristics Prediction and Modification This is a subject of everyday interest and in some parts of the world of day by day interest here the frames of reference of human time and geological time coincide Because of its social ramifications this topical subject might be called an example of applied geophysics

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