

Hot topics in geophysics: Progress, trends, and perspectives

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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	Biologic/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	

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Topics In Geophysics

Karin Nielsen-Saines



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Table of Contents Topics In Geophysics

1. Understanding the eBook Topics In Geophysics
 - The Rise of Digital Reading Topics In Geophysics
 - Advantages of eBooks Over Traditional Books
2. Identifying Topics In Geophysics
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Topics In Geophysics
 - User-Friendly Interface
4. Exploring eBook Recommendations from Topics In Geophysics
 - Personalized Recommendations
 - Topics In Geophysics User Reviews and Ratings
 - Topics In Geophysics and Bestseller Lists
5. Accessing Topics In Geophysics Free and Paid eBooks
 - Topics In Geophysics Public Domain eBooks
 - Topics In Geophysics eBook Subscription Services
 - Topics In Geophysics Budget-Friendly Options

6. Navigating Topics In Geophysics eBook Formats
 - ePub, PDF, MOBI, and More
 - Topics In Geophysics Compatibility with Devices
 - Topics In Geophysics Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Topics In Geophysics
 - Highlighting and Note-Taking Topics In Geophysics
 - Interactive Elements Topics In Geophysics
8. Staying Engaged with Topics In Geophysics
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Topics In Geophysics
9. Balancing eBooks and Physical Books Topics In Geophysics
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Topics In Geophysics
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Topics In Geophysics
 - Setting Reading Goals Topics In Geophysics
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Topics In Geophysics
 - Fact-Checking eBook Content of Topics In Geophysics
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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