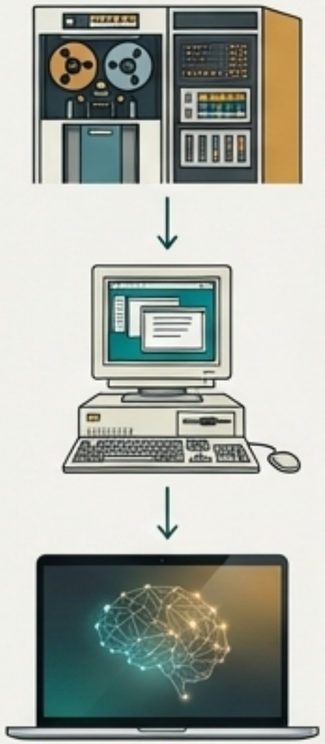
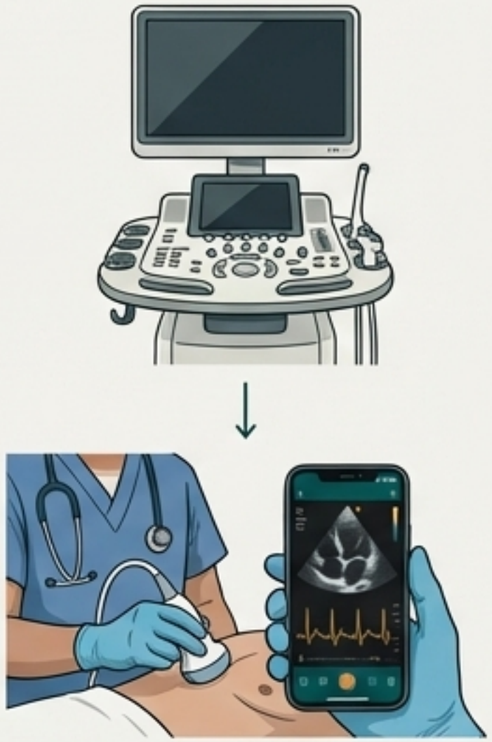
The World and Technology Are Evolving. Is Oil Exploration Evolving Too?

Computing



Communication

Medical Diagnostics



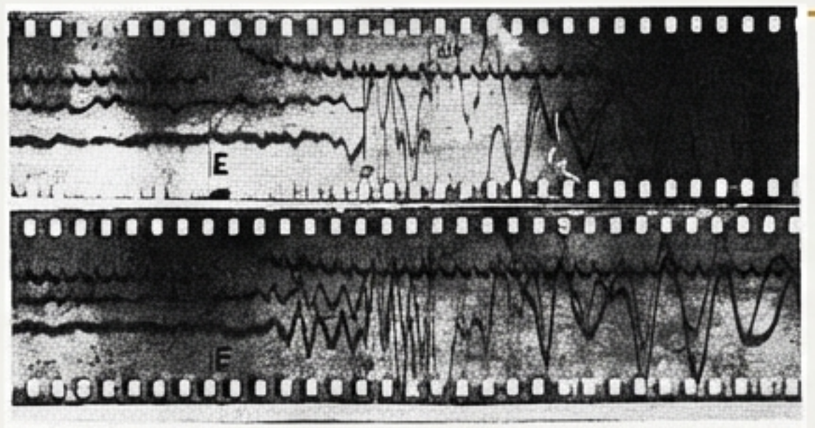
Across every industry, technology has shifted from large, centralized, brute-force tools to intelligent, targeted, and distributed systems.

We've seen this in computing, communication, and even medicine, where a heart ultrasound can now be done with a smartphone. This evolution reduces investment, simplifies logistics, and speeds up diagnosis without compromising usefulness.

Is our industry keeping pace with this paradigm shift?

Exploration's Foundation: A Century of Seismic Innovation

Since the first commercial oil discovery using refraction seismic in 1924, geophysics has been the bedrock of exploration.



1920s

1930s

- From 1D subsurface imaging...

1940s

1950s

1960s

1970s

1980s

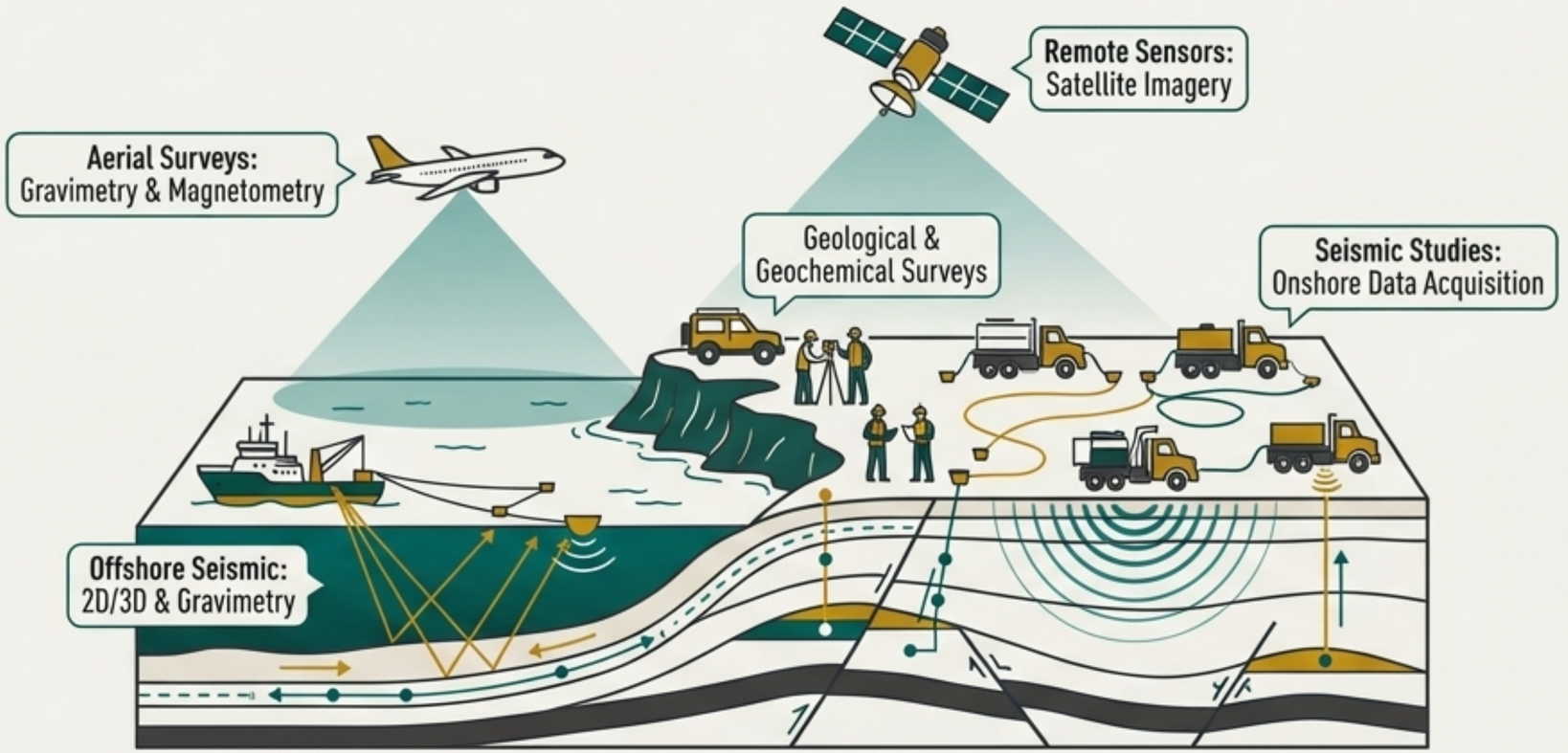
1990s–Today

...to 4D monitoring today, the industry has consistently evolved its tools to see deeper and with greater clarity.

"The beginnings of reflection seismology were met with skepticism... the author... certainly remembers many occasions when reflections were not even considered on a par with the divining rod..."

The Modern Challenge: Exploration by Brute Force

Today's exploration relies on a powerful but resource-intensive toolkit. We blanket vast areas to find potential.



- **High Cost & Time:** Seismic surveys using vibration or explosives remain expensive and slow.
- **Indirect Information:** Most methods provide geometric or structural data (e.g., traps, faults), not a direct signature of fluids or mineralogy.
- **Logistical Complexity:** Involves massive manpower, extensive logistics (access roads, helicopters), and equipment deployment.
- **Growing ESG Constraints:** Social acceptance is increasingly difficult due to noise, permits, and environmental limitations.

The Operational Bottleneck: Unraveling the Seismic Scheduling Program (SSP)

Definition

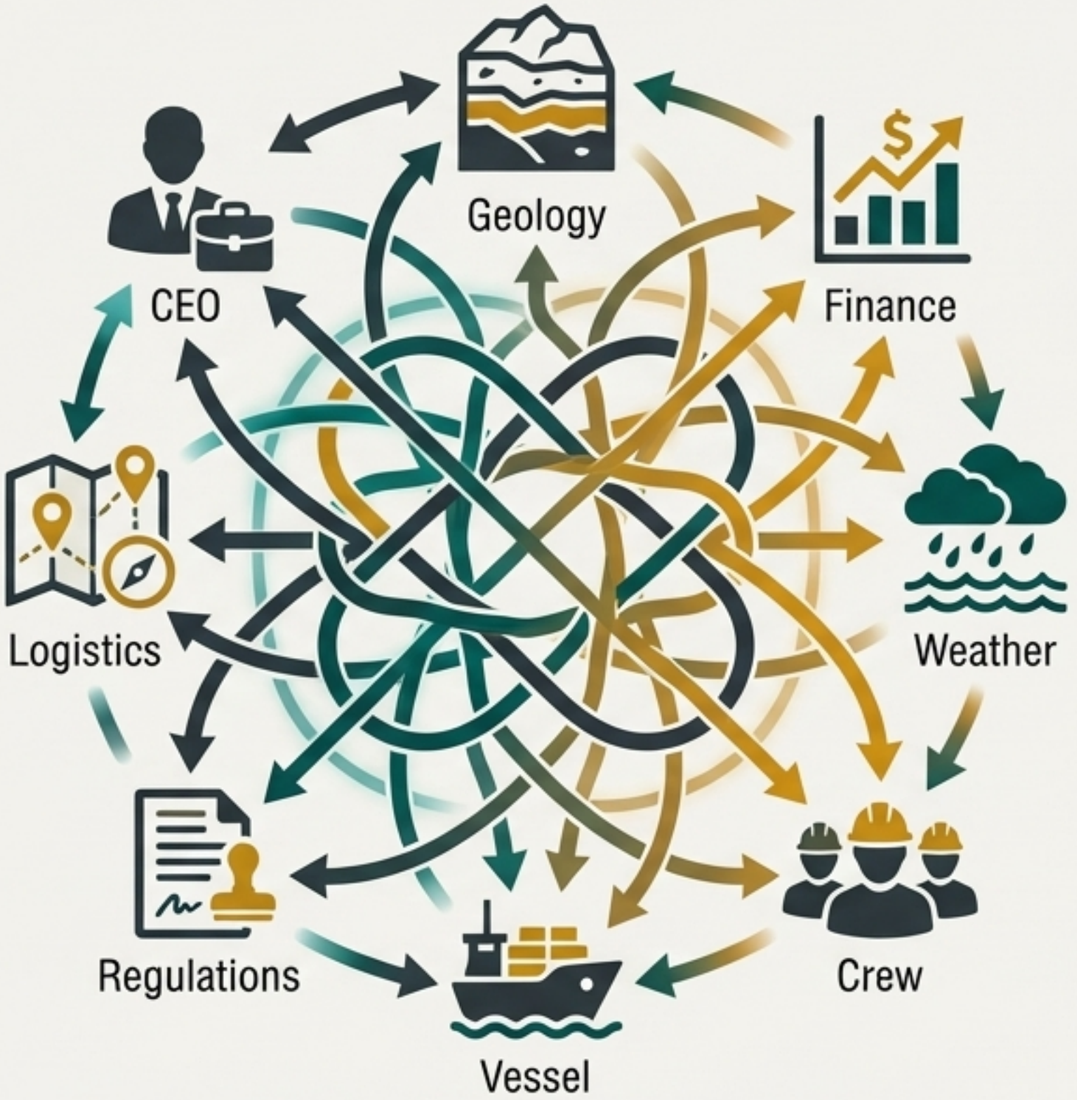
The SSP is the systematic planning and optimization of all seismic acquisition activities. Its goal is to decide **when, where, and with what crews, vessels, sources, and receivers** each survey will be executed to meet data quality objectives at minimum cost and risk.

The Complexity

- Weather and sea conditions
- Environmental and regulatory windows (wildlife, fishing seasons)
- Crew, vessel, and equipment availability
- Customer delivery deadlines
- Potential interference between surveys

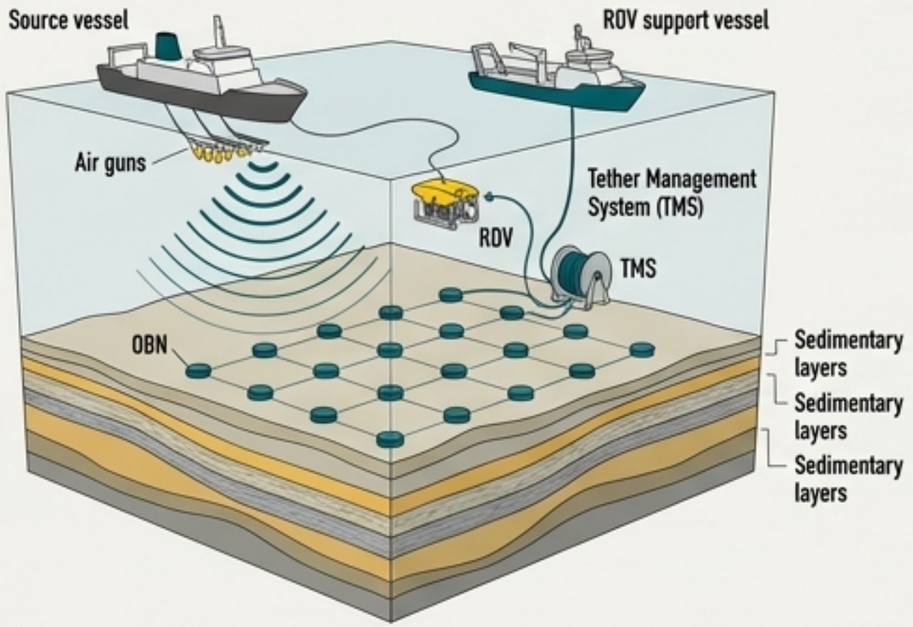
The Bottom Line

In practice, the SSP is a massive resource allocation problem where multiple high-stakes projects compete for limited operational resources.



Today's Tools Are Powerful, Precise—and Amplify the Cost of Uncertainty

Ocean Bottom Nodes (OBN)



Autonomous, four-component nodes provide unparalleled data quality in a low-noise environment. But their high cost has traditionally limited them to appraisal and development. Deploying them for broad exploration is a major CapEx decision.

Compact Terrestrial Nodes (Stryde)

Miniature, cable-free nodes are revolutionizing land seismic, enabling high-density surveys in difficult terrain with a lower environmental footprint. However, mega-surveys still represent a significant investment in time and resources.

These technologies provide incredible resolution, but deploying them without knowing where to look is like using a surgical tool for a landscape survey—powerful, but inefficient.

A New Paradigm: Shifting from Brute Force to Intelligence

The next evolution in exploration isn't just a better sensor; it's a fundamentally smarter methodology.

RSS NMR

THE SIMPLE WAY OF EXPLORATION

GEO-NMR.NET

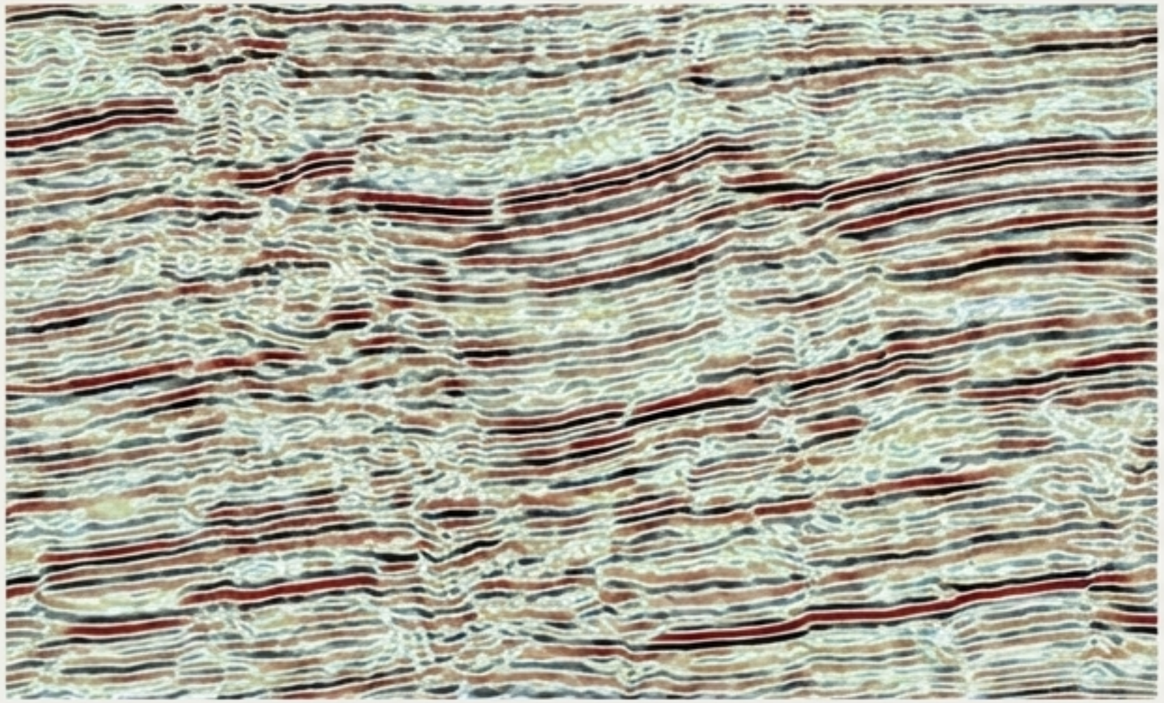
Exploration by satellite

Introducing RSS-NMR: A combination of Remote Sensing (RSS) and Nuclear Magnetic Resonance (NMR) technology that provides a fast, economic, and **physics-based pre-screening** of your acreage.

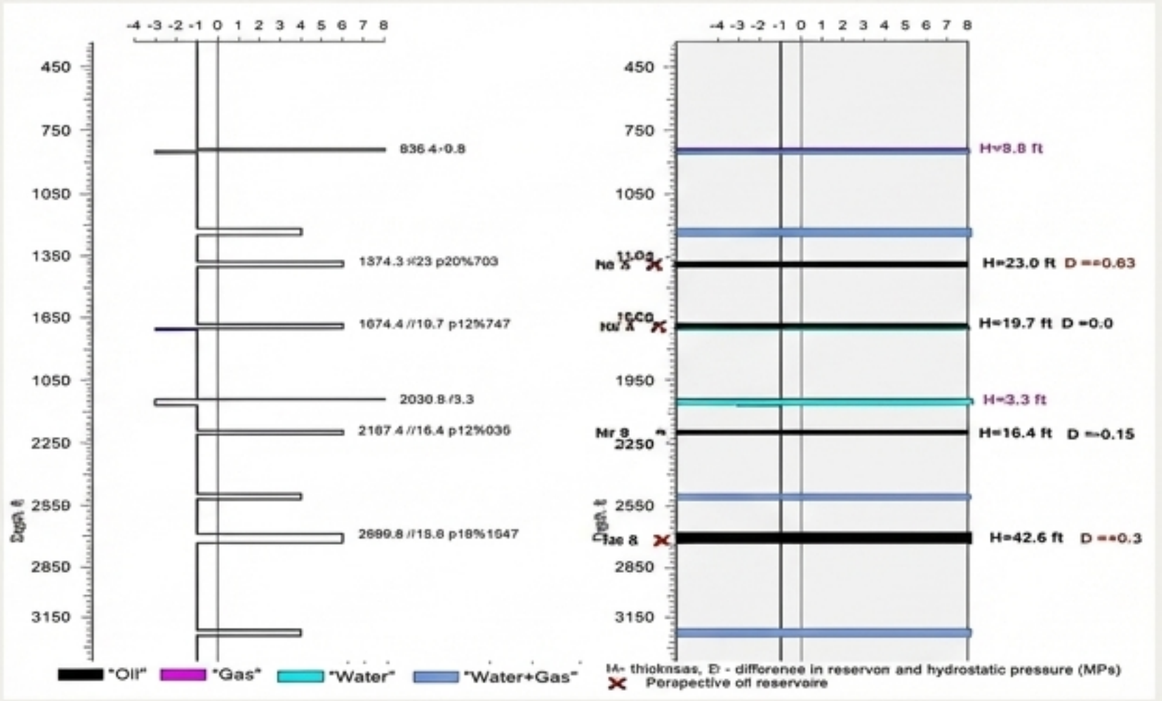
Before committing millions to seismic or drilling, RSS-NMR gives you a direct indication of where hydrocarbons are most likely to be found. It allows you to explore with intelligence, not just force.

The Critical Difference: From Complex Interpretation to Direct Indication

Interpretation is needed



Interpretation is not needed

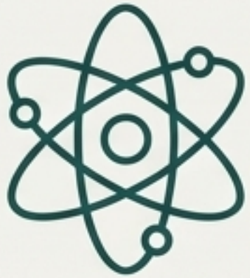


Seismic Data:
Seismic provides a detailed structural image of the subsurface. It is essential for understanding geology, but identifying hydrocarbons requires complex, model-dependent interpretation.

RSS-NMR Data:
RSS-NMR directly measures the response of fluid molecules (like oil, gas, and water) in the subsurface. The result is a clear, direct log of potential reservoirs, their thickness, and fluid type, minimizing ambiguity.

How RSS-NMR Delivers Actionable Intelligence

Physics-Based Measurement

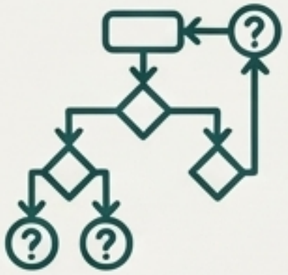


Physics-Based Measurement: NMR provides a direct measurement of fluids in pore spaces (fluid hydrogen). It differentiates between free and bound fluids, a key factor in reservoir evaluation.

Reliable Pre-Screening

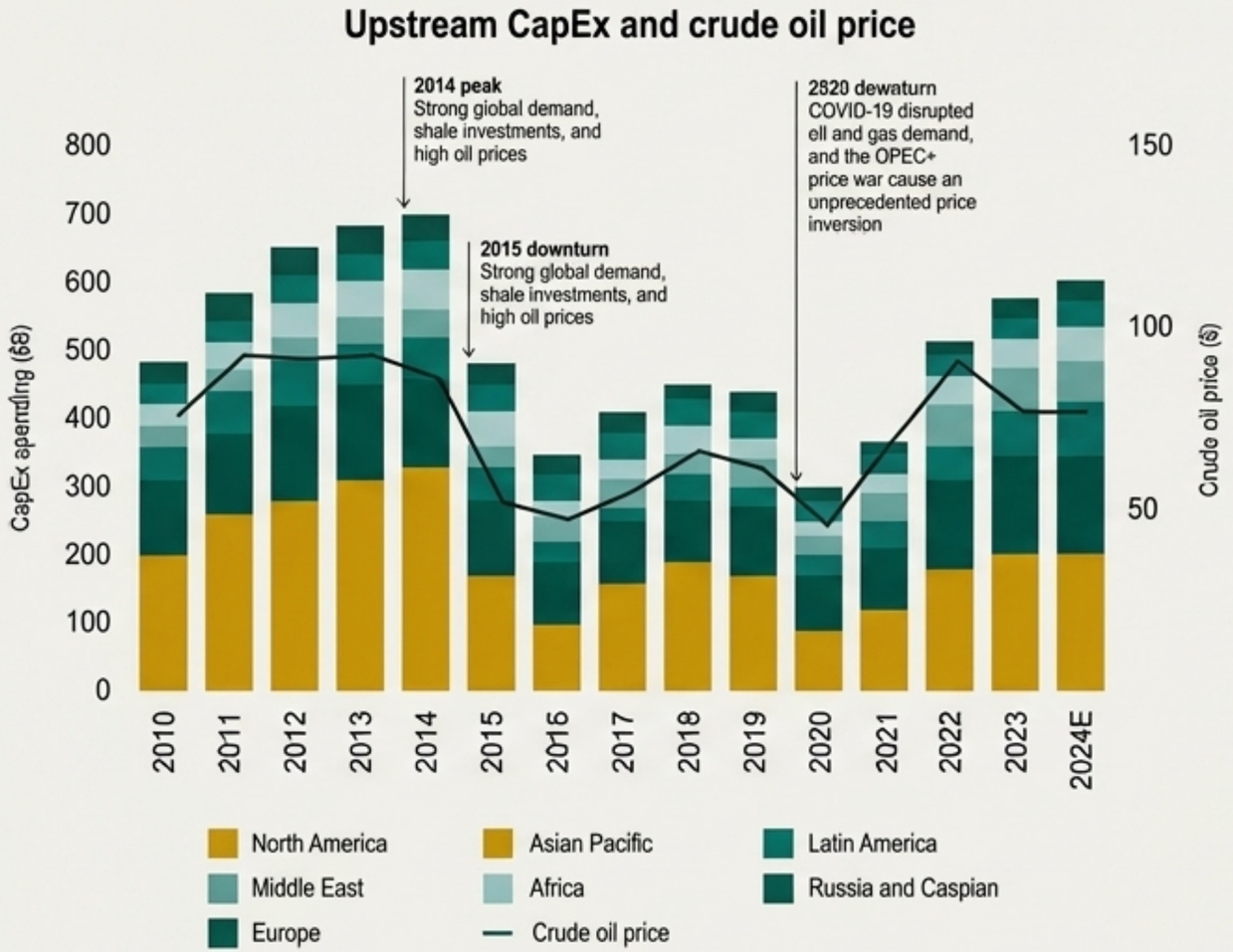
Reliable Pre-Screening: Identifies and delineates hydrocarbon, mineral, and groundwater anomalies. Estimates depth and geometry down to several kilometers. Achieves reliability of **~60-80%** after remote work and **~90%** after field validation.

Informing Key Decisions



Informing Key Decisions: With this data, you can make better decisions on seismic strategy *before* deployment. Do you need expensive full-azimuth OBN, or will targeted vibroseis suffice? Should you use ultra-dense Stryde nodes, or focus on deep-sensing-ensing MT? Design survey geometries only over the most promising zones instead of covering the entire block.

The Economic Imperative: De-Risking CapEx in a Volatile Market



For a typical 1000 km² exploration area, an RSS-NMR survey costs less than 1% of a full geophysical program or a single exploration well.

Key Economic Benefits

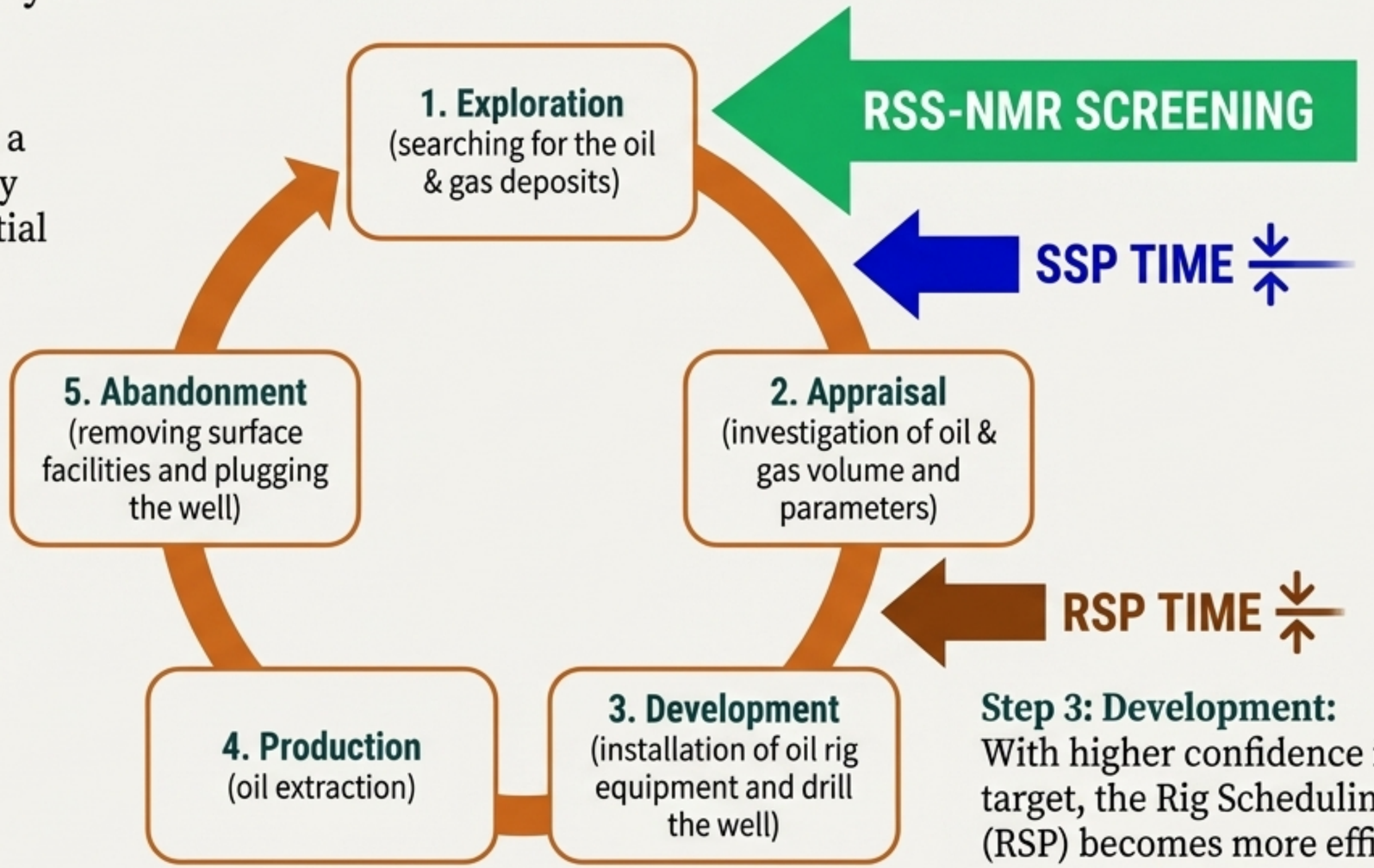
- **Drastic Cost Savings:** Eliminate the need for broad 2D reconnaissance seismic and reduce the required 3D survey area to the ‘core’ volume.
- **Budget Optimization:** Spend your OBN / Stryde / Vibroseis / MT budget only where the value is highest.
- **Portfolio De-Risking:** High-grade blocks into high, medium, and low potential *before* committing to high-CapEx seismic and drilling.
- **Avoid Dry Holes:** Reduce the risk of acquiring expensive data over barren structures.

Re-Engineering the Exploration Workflow

RSS-NMR screening is not an additional step; it's a strategic intervention that fundamentally streamlines the entire lifecycle.

Step 1: Exploration:
Before any heavy geophysics, a fast, low-cost RSS-NMR survey identifies and ranks all potential anomalies across the block.

Step 2: Appraisal:
The results directly guide a much smaller, targeted seismic and/or MT program. This drastically shortens the Seismic Scheduling Program (SSP).



Step 3: Development:
With higher confidence in the target, the Rig Scheduling Program (RSP) becomes more efficient, reducing the time to first oil or gas.

Transforming the SSP: From 'How to Do Everything Everywhere' to Strategic Focus

The question is no longer "How do we survey the entire block?"

How do we efficiently concentrate our best seismic tools on the most prospective 10-20% of the block identified by RSS-NMR?

The New SSP Process

1. **Start with RSS-NMR:** Screen the entire block or portfolio.
2. **Select 'Hot Spots':** Identify a small subset of high-probability targets.
3. **Targeted Planning:** Develop detailed seismic/OBN/MT campaigns *only* for these validated hot spots.

The Result: The SSP transforms from a complex, multi-project scheduling problem into a much simpler, value-driven planning exercise.

Making Your Best Tools Smarter and More Effective

RSS-NMR does not replace high-resolution seismic or the deep investigation of MT. It makes them more targeted, efficient, and impactful.

For OBN (Ocean Bottom Nodes)

Remains the gold standard for complex offshore imaging (salt, obstructed areas).

Impact: Deployed over **significantly smaller areas** pre-selected by RSS-NMR, dramatically **reducing overall project timelines and acquisition CapEx.**

For Land Seismic (Vibroseis/Stryde)

Impact: The grid size and number of profiles to be acquired can be **significantly reduced.** This **simplifies crew scheduling, decreases land-use conflicts, and minimizes exposure** to critical time windows (rainy seasons, agricultural use).

For Magnetotellurics (MT)

Impact: Repositions MT from a broad exploratory tool to a **deep calibration tool.** Used on a **limited number of transects** where RSS-NMR indicates favorable deep structures.

A New Methodology with Clear Strategic Advantages

Economic & Financial

- Drastically reduces exploration costs (<1% of conventional methods for initial screening).
- Optimizes CapEx by focusing expensive tools on validated targets.
- Improves project NPV by prioritizing areas with the highest probability of success.

Operational & Logistical

- Vastly simplifies the Seismic Scheduling Program (SSP).
- Reduces acquisition and processing timelines significantly.
- Provides flexibility to reschedule campaigns to other vetted areas if operational issues arise.

Technical & Subsurface

- Fundamentally reduces exploration risk with direct, physics-based fluid detection.
- Enables early high-grading of prospects and portfolio ranking.
- Integrates seamlessly with existing seismic and MT data to validate targets.

ESG & Social License

- Minimizes environmental footprint with less need for line-cutting and vehicle traffic.
- Reduces noise and community disruption.
- Streamlines permitting by targeting smaller, more defined areas of interest.

The Future of Exploration is Pragmatic and Targeted

The emerging pattern for efficient and responsible exploration is clear:

1 Wide-Scale Screening

Use RSS-NMR and hyperspectral remote sensing for detection and vectoring at the basin or block scale.

2 Targeted Geophysics

Follow up **only** with focused seismic surveys and appraisal drilling on the validated "**sweet spots**."

This approach addresses both economic pressures (CapEx) and ESG constraints (less noise, fewer surface disturbances).

****Future-Ready****

This methodology also aligns with the growing trend of combining NMR data with AI (neural networks, transformers) for advanced fluid identification and reservoir characterization, further strengthening the case for this strategic shift.

Engage with the Future of Exploration

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