

# The Science of Shale, Schlumberger Unconventional Resources

47-Page Book

A New Era - International Expansion, Spread Overview

Although shale resource estimates will likely change over time, the initial estimate of technically recoverable shale gas resources in 41 countries is 7,299 trillion cubic feet (Tcf).<sup>†</sup> To put that into perspective, just 1 Tcf is enough to heat 15 million homes for a year.<sup>‡</sup> For all shale, including liquids, conservative estimates for oil and gas resources exceed 2 trillion barrels of oil equivalent.

## International Expansion

The shift to shale holds enormous potential for countries such as China, South Africa, and Argentina, which sit atop wide expanses of organic shale resources. Unconventional resource development will create millions of jobs and provide centuries of clean, domestic power. However, operators must first overcome completion quality challenges—and address infrastructure, land access, regulations, and the acceptance of hydraulic fracturing by local populations.

## Shale Potential

All over the world, operators seek the vast oil and natural gas resources still residing within these ultralow-permeability organic mudstone sediments. The potential of shale is tremendous, but converting these resources into commercially viable reserves requires breakthrough technology and the right economic conditions. In this modern industrial age, we must provide affordable and plentiful energy for future generations—while extracting resources in a safer, more environmentally responsible manner.

*Organic source rocks have been found on every continent. These are just some of the most significant unconventional oil and gas deposits around the globe.*

## Spotlight on China

The US Energy Information Administration (EIA) estimates that China has 1,115 Tcf of technically recoverable shale gas, making it the world's largest shale gas resource. Still in the early exploration phase, China must find a way to develop these resources despite challenges such as hilly terrain, high population density, limited transportation, and constrained water supply. It has set an ambitious goal of producing more than 2,000 Bcf/year—a staggering 6% of its energy needs—by 2020.

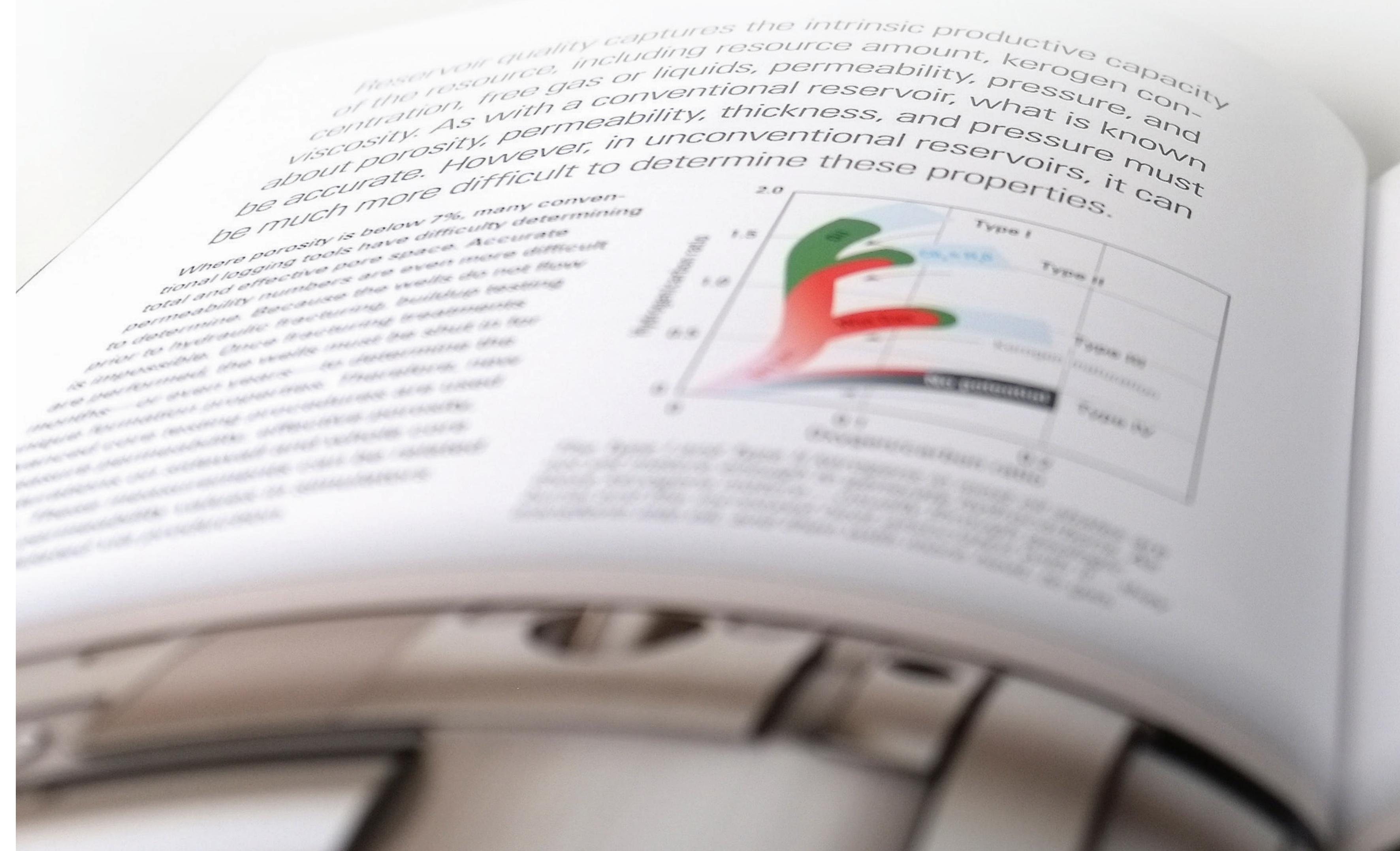
*The Science of Shale* addresses multiple topics, from the emerging global shale market to the development of new services and products. Read about these topics and more in the attached book, carefully returning it into the pocket afterwards so that others may also enjoy.



# The Science of Shale

*The Science of Shale* explores the various processes and technologies used in finding, developing, and producing shale resources. Once viewed as uneconomic source rock, shale reservoirs have become much sought after; new developments have made their production commercially viable while addressing safety, environmental, water, and land-use sustainability concerns. This booklet addresses multiple topics, from the emerging global shale market to the development of new services and products.

Also discussed are the characteristics of shale reservoirs, including permeability, heterogeneity, and basinal architecture. Throughout *The Science of Shale*, facts relating to shale introduce the theme of each chapter. The dynamic layout incorporates case studies as well as multiple sidebars for a more in-depth look at current services used for shale operations.



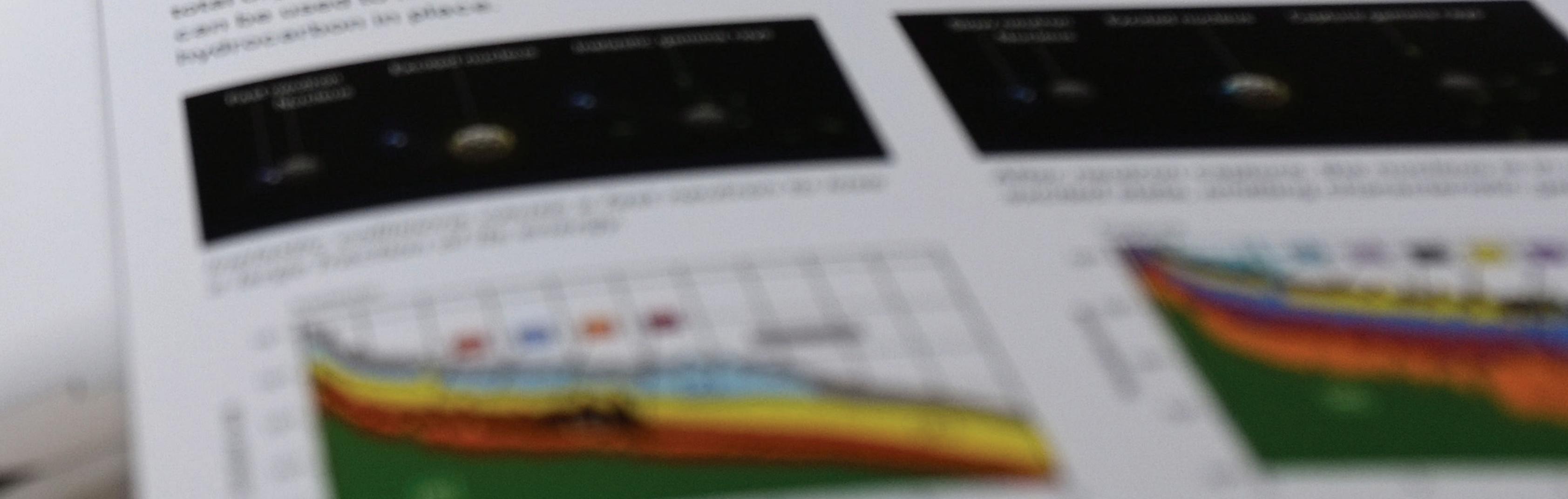
## Determining Pressure

In shale, obtaining an accurate measure of pressure is challenging because buildup tests are not viable. Bottomhole pressure gauges on perforating guns, and shooting fluid levels also suffer from the inherent challenge of ultralow permeability. Given these obstacles, operators often locate in test to break the rock. Following the injection, the created disturbance can be monitored for a few days or weeks to determine a value for pressure.

All of these parameters, including pressure-volume-temperature (PVT) properties, go into determining reservoir quality. The better the reservoir extent, hydrocarbon content, permeability, and pressure are, the better the play's potential. Creating maps of RQ across a given play helps engineers select drilling locations and sweet spots.

## Elements of Spectroscopy

In shale plays, high-definition gamma ray spectroscopy uses both inelastic scattering and thermal neutron capture to determine elemental weight fractions, mineralogy, and total organic carbon (TOC) for defining reservoir quality in complex lithologies. This data can be used to more accurately estimate hydrocarbon-filled porosity and, ultimately, hydrocarbons in shale.



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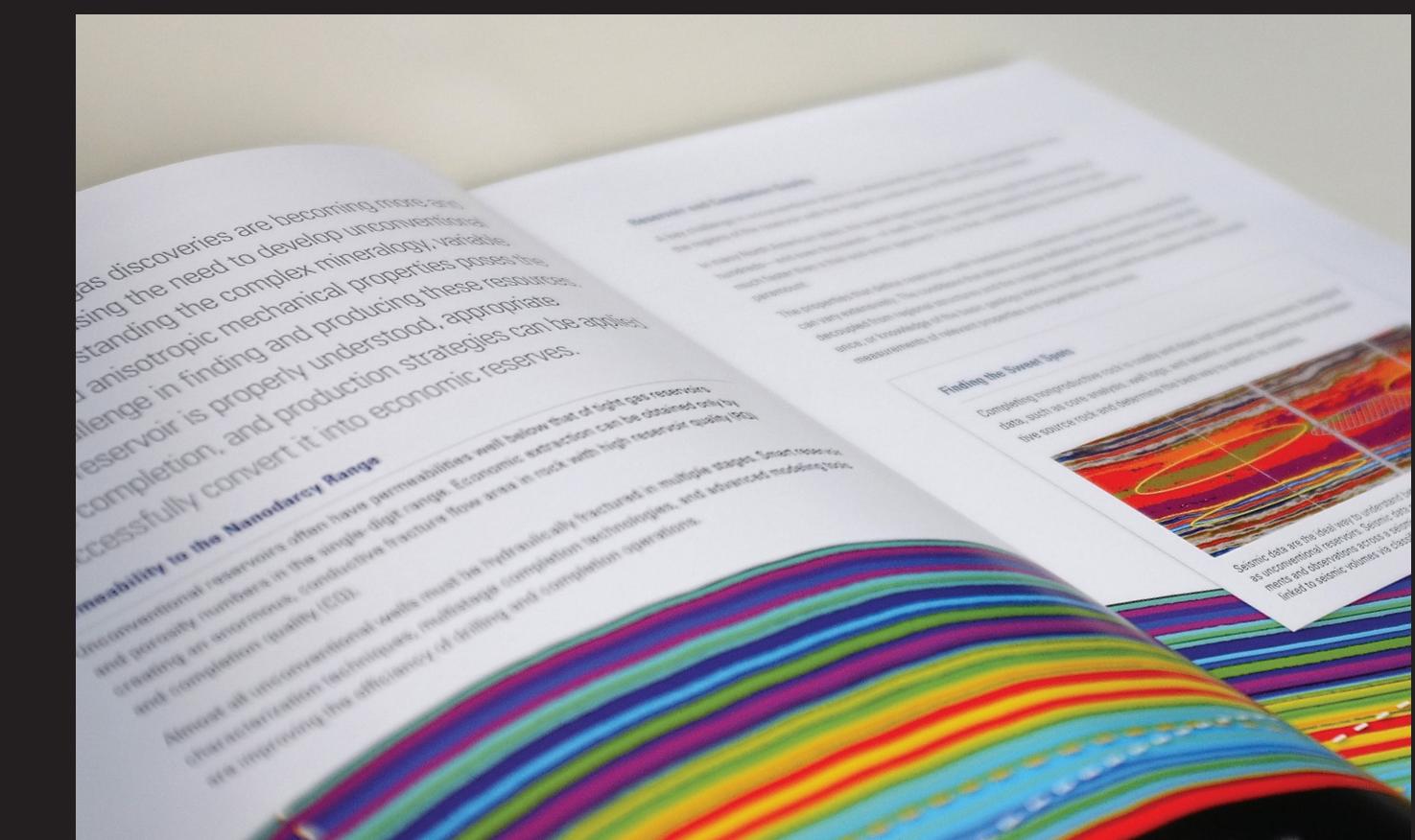
Chapter 1 - Unconventional Resources, Introduction Detail



Chapter 5 - Completion Quality, Detail



Chapter 1 - Unconventional Resources, Detail



Chapter 8 - Integration And Collaboration, Detail

