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A QUARTERLY REVIEW OF THE LATEST NEWS

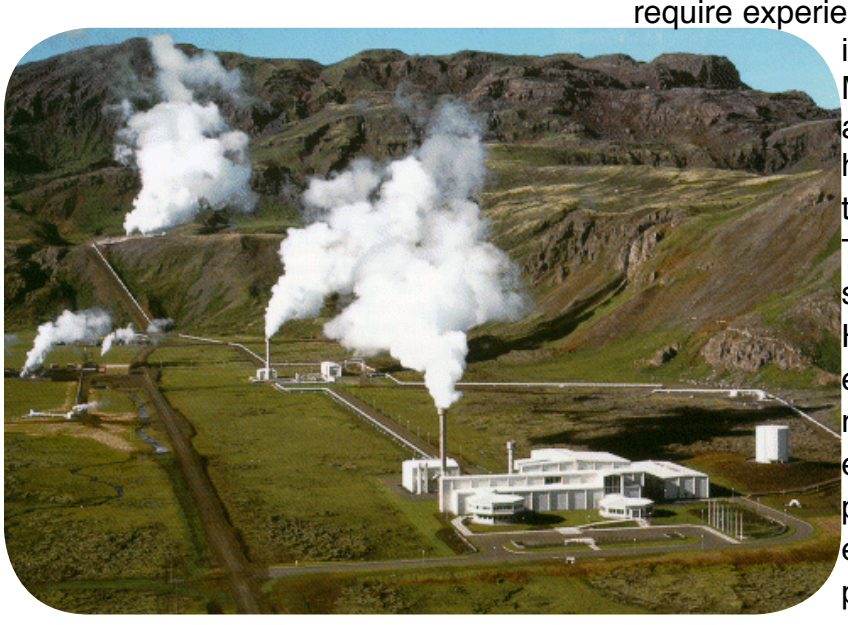
SWORD

In this issue

Geothermal Energy's High Pressure & High Temperature Wells Solutions

There has been a great deal of offshore development activity in Asia, although the area has not traditionally been perceived as a deepwater hot spot. The region is predicted to see substantial growth in deepwater development activity in the future.

This comes at a time when a surge in renewable energy demand and intensifying energy security concerns have directed international attention towards geothermal energy. Current global geothermal energy generation is now at about 11,000 MW and estimates suggest that this number will more than double in the next 10 years – amounting to an investment of some USD40 billion.



The following factors are fueling this geothermal growth:

- **economic progress, especially in developing markets**
- **increasing concerns over energy security and its impact on economic security**
- **electrification of low-income and rural communities**
- **emergence of low-cost and efficient technologies**
- **rising environmental awareness**

With the new growth come challenges. Operators in this region encounter steeply fluctuating depths in the enormous shifting salt formations that lie miles below the ocean floor. Remote locations and difficult currents require experience when working offshore in Asia Pacific.

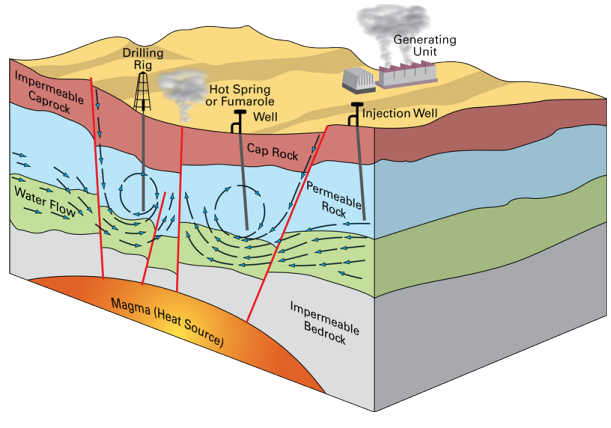
Many of the region's wells also require high pressure/ high temperature (HPHT) tools.

The industry leading specifications of Kuster HPHT tools increase efficiency by providing fast, reliable readings under extreme temperatures and pressures. Depending on exact temperatures and pressures, Kuster tools alone may be the only ones capable of delivering accurate readings in many reservoirs.

Geothermal energy — What is it?

Geothermal energy is the energy stored in the form of heat beneath the earth's surface. Geothermal energy is a carbon free, renewable, sustainable form of energy that provides a continuous, uninterrupted supply of heat that can be used to heat homes and office buildings and to generate electricity.

Our planet is a huge source of energy. In fact 99.9 per cent of the planet is at a temperature greater than 100°C; so geothermal energy is a significant renewable resource.



Simplified Diagram of Geothermal Plant

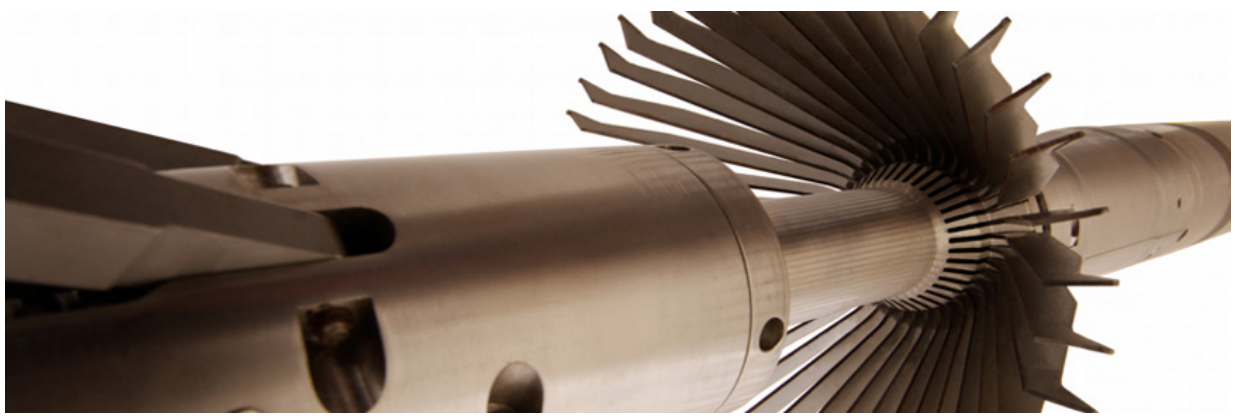
Source: British Geographical Survey

Kuster
a Probe company

Kuster HPHT Wells Solutions Technology

The challenges of efficient and effective oil and gas extraction ultimately depend on the accuracy and understanding of the information that is learned about the subsurface. One of the cornerstones of downhole measurements is downhole pressure and temperature gauges, used predominantly to assess fluid properties and boundaries within the downhole environment. From the simple and efficient mechanical pressure gauges developed in the 1940's to the more sophisticated electronic pressure gauges that are in general use today, the industry has just about kept pace with environmental challenges that downhole tools and systems have to endure as we go deeper and into more hostile and demanding reservoirs to assess their commercial producability.

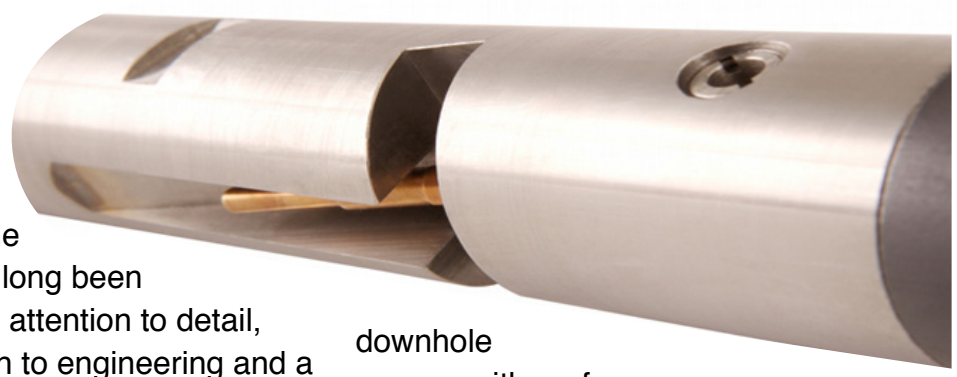
Of the two pressure and temperature variables, pressure is relatively easy to contain. Today's sophisticated mechanical engineers can design pressure containment systems and barrier systems that will protect the internal electronics from the crushing pressures present external to the tool. On the other hand, protecting the internal tools form excessive temperatures can be a little more demanding. The excessive external temperature is conducted through the tool into the internal electronics and proceeds to "cook" the internal electronics. Some protection can be afforded by flasking the internal electronics in a similar way to vacuum flasks keeping their contents warm or cool, but this only slows down the process. In fact, if not properly controlled or modeled, aerospace engineers have investigated these types of problems for many the flasking process may exacerbate the issue as any internal heat generated by the internal electronics can no longer escape, and the tool will potentially cook itself from the inside. Assessing the temperature capability of tools is not a simple process and should always be considered as a function of time. A tool may survive 150C (300F) for 10 minutes, but what about 100 minutes? It's not a simple process, as components fail, the internal circuitry delaminates and the entire circuit system starts to behave in a totally different way. Many years of research and development findings have led to improved electronic board design, new materials (polyimide) and some more sophisticated fabrication techniques. Despite all these incremental improvements, the performance and longevity of accurate electronic gauges has improved only marginally over the last decade.



Until now.

The team behind the Kuster gauges has long been recognized for their attention to detail, innovative approach to engineering and a relentless passion for providing the best, most cost-effective gauges and systems in the business. Reputation is everything in oil and gas business and the Kuster technology has earned its reputation over the last 80 years. To drive gauge performance to a new level, the team knew they had to do something different. After a discussion with one of their key partners, Quartzdyne, it became clear that it might be possible to significantly push the envelope by leading the pack in the application of hybrid electronic technology in the oil and gas industry.

Quartzdyne, a leading global manufacturer of quartz gauges, had developed its own hybrid quartz pressure transducer to improve the overall reliability of its pressure transducer. The Kuster team, lead by industry veteran John Jacobson, knew that the secret lay in developing a complete hybrid system. Quartzdyne had improved their sensor component and some of their customers were jumping on the "hybrid bandwagon" by incorporating this new hybrid component into their gauges. "We know that if want to make a step-change in performance, we have to put everything into it" stated John Jacobson, "cutting corners doesn't work in this business." And so, like the true pioneers that they are, the Kuster team set about creating the next generation of commercial downhole gauges with performance characteristics that should meet or exceed the downhole requirements for the next 20 years. The proven Kuster electronic boards, proven for over 20 years in the field, were hybridized. A complicated process of removing plastics and thermo-sensitive material from the board, providing a solid state substrate for mounting components, and a ceramic insulator to ensure integrity, all encased in a rugged metallic enclosure that would fit inside the existing pressure testing tool housings.



The Kuster team has proven again, that the boundaries of what we thought was possible can be exceeded when we function as a team, apply a modular approach to engineering the solution, and provide a healthy does of innovation to overcome the inevitable barriers that we face as we strive to meet tomorrow's challenges today.