HGS Bulletin
Houston Geological Society
Volume 63, Number 3
November 2020

R.E. Sheriff Lecture Hess's Journey into an Emerging Superbasin and Ultra-High Impact Exploration for an Independent E&P Company

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In Every Issue

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Technical Meetings

Other Features

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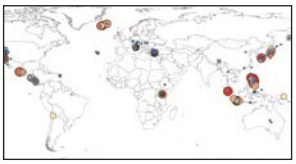

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About the Cover: Natural steam vent in Svartsengi geothermal field on the Reykjanes ("smoking") Peninsula on the southern coast of Iceland, near Reykjavik. The collapsed boardwalk attests to the unstable surface of this historic active volcanic area. In January 2020, more than 8,000 earthquakes were recorded due to rising underground magma (K. Ravilious, 2020, *The Guardian*, April 10).
Photo by Wayne Camp


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Settling In

As you are reading this, we have just successfully completed the fifth session of our five-week biennial Africa Conference. This annual event is held in alternation with the Petroleum Exploration Society of Great Britain (PESGB), and this twentieth edition was not like the earlier ones. This event has been in-person in the past, over two days. In order to accommodate safety considerations and travel restrictions, two-hour sessions on every Thursday morning in October allowed over one hundred registrants for each session to view them over multiple time zones. Most of the presentations were prerecorded, allowing presenters to refine their talks and adhere to time limitations, and allowing for live questions and answers between attendees and presenters. We also had some prerecorded students presentation, including students from Africa. This provides a template for remote attendance of future events, as a possible addition once we are able to return to in-person events.

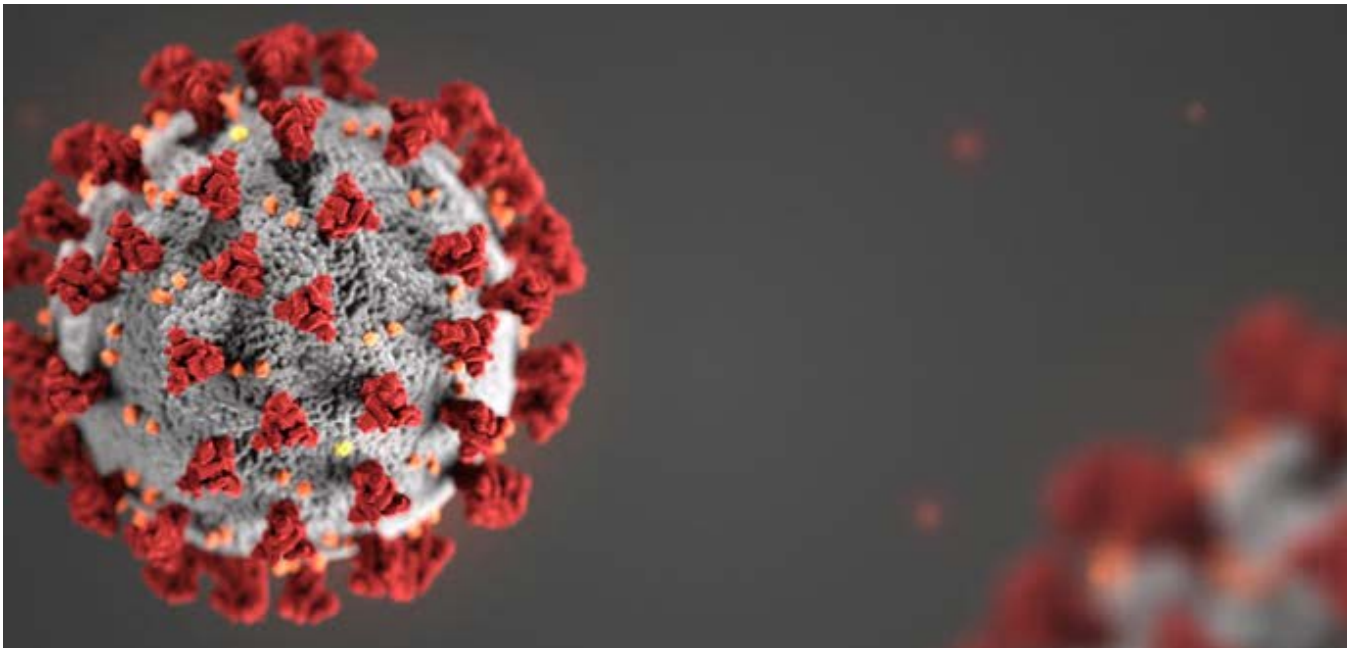
The first session was at the same time as both the AAPG Annual Convention and Exhibition (ACE) and the annual GCAGS GeoGulf meetings, an embarrassment of riches and confusion for some of us. The AAPG session presentations were recorded, and may be viewed by registrants for several weeks more. It is always frustrating at this convention to try to catch all the interesting concurrent presentations one would like to, so this is a solution allowing for full saturation of the content. Now, if there were only more unconflicted hours in the day to take it all in.

I think we are now appreciating the in-person events we cannot have at present. Watching on a screen lets us take in the content, sometimes repeating parts that raise questions in our minds. But we miss the hallway conversations and face-to-face interactions.

I think we are now appreciating the in-person events we cannot have at present. Watching on a screen lets us take in the content, sometimes repeating parts that raise questions in our minds. But we miss the hallway conversations and face-to-face interactions. Some traditional meeting aspects may change forever, others will return after extended hiatuses. We have learned the difference between yoga webinars (instructional) and webinar yoga (postures practiced when a webinar starts to drag). Change can force us to look at our processes and modify them if needed. Some of the content delivery from the HGS will change, or be augmented.

I hope everyone is using small bits of available time to renew contacts that have lapsed and maintain their networks. With all the disruption for many of us, we need our networks to be fresh and available. ■

Be safe and volunteer for something this month.
Jim Tucker



Coronavirus (COVID-19) Policy Statement: Updated Friday, October 30, 2020

Because of the ongoing coronavirus (COVID-19) situation, all in-person HGS events through the end of 2020 are cancelled/postponed or will be substituted by online events. Please check the HGS website on a regular basis for all HGS online event opportunities.

The HGS Board will continue to monitor the situation and determine whether to extend the cancellation or postponement of HGS in-person events as we enter the New Year.

Please monitor hgs.org and your email for further communication concerning HGS events.

For more information about how you can help to prevent the illness, visit the CDC website: https://www.cdc.gov/.

2020-2021 HGS Board

Ceri Davies
editor@hgs.org

How Does a Geologist Transition?

Hello again rock friends, With winter rapidly approaching and temperatures soon to drop, akin to what we are witnessing with the oil price, the ongoing uncertainty around the Oil and Gas industry continues to fuel concerns about the future and even the best laid out plans have to be redrawn.

Over the past couple of weeks we have seen several announcements and transactions around companies merging or being acquired, with Chevron-Noble, Devon-WPX, ConocoPhillips-Concho, Cenovus-Husky and Chrysaor-Premier Oil all making the headlines.

On a daily basis we see the media reporting that the end of the oil industry is nigh and that it is time for all of us to transition to other industries. I appreciate that the oil industry is going through some changes and that, unfortunately, we will see a reduction in the number of colleagues and friends we get to work with. However, the World still needs energy and even in considering a transition away from fossil fuels, the 2020 BP Energy report makes it clear that oil and gas will be a fundamental part of the energy mix for many decades to come, the oil industry lives. There are also some features of our part of the industry that are unique and some elements of our roles that go beyond the nine to five. Many of us undertook a career in geology because of the passion we have for the subject and we have been lucky enough to convince someone to pay us to fulfill our hobby. A career as a geologist is unlike any other, and asking a geologist to transition does not come easily. Whilst some of us may transition away from the oil and gas industry, we'll always remain geologists.

The realization that we can make a career from understanding the natural sciences first dawned on me during a family holiday to Iceland prior to my senior years in high school. For those who have not yet had an opportunity to visit Iceland, if ever the chance presents itself in the new normal, I encourage you to spend at least a week there. Tectonics, volcanism, geothermal energy – all accessible to explore and part of daily life in a country that is a star player in natural wonders.

However, the World still needs energy and even in considering a transition away from fossil fuels, the 2020 BP Energy report makes it clear that oil and gas will be a fundamental part of the energy mix for many decades to come, the oil industry lives.

All of which leads me to my closing comments. As mentioned in my note last month, a few weeks ago we took a long weekend camping trip to Waco. We visited the Grayson Formation near Lake Waco and then stopped at the Waco Mammoth National Monument. With two 1st graders, the outcrop provided an excellent opportunity to explore and look for fossils. The tour guide at the mammoth site highlighted the careful excavation and analysis their team undertake to understand the history of the mammoths and how they came to rest at that location.

My oldest, with a projected height of 5'7", has got big plans of being a point guard for the Houston Rockets. His brother, when asked during his classroom discussion "what do you want to be when you're older" – "wants to work at the place where we saw the mammoths, because he likes digging in dirt". ■

Until next month and Happy Thanksgiving,
Ceri

Penny sized mid-Cretaceous ammonites in the Grayson Formation, near Lake Waco.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WHY SHOULD YOU ATTEND?

The HGS (Houston Geological Society) and EAGE (European Association of Geoscientists and Engineers) will host for the second time the Latin American conference that will take place in a fully virtual format, between the 1st and the 3rd of December 2020. On this occasion, the HGS/EAGE will bring an integral and exceptionally enriched conference on Latin America.

Since the last two decades, the Latin American region has faced continuous development in energy resources, which has opened to increased investment. In recent years, the oil and gas industry has significantly increased exploration and production activities in the southern Caribbean margin, the Andean foreland, Guyana-Suriname offshore, deep-water Brazil, Argentina and Uruguay offshore, unconventional exploration in Argentina and Colombia, and the opening of exploration areas on the Pacific margin of South America. All this makes the second HGS/EAGE Conference on Latin America a perfect setting to keep up with the latest in Petroleum Geoscience for Conventional and Unconventional E&P, Natural Resources and Ore Geology, Machine learning present and future role in exploration, Seismic Imaging in E&P, that in overall, contribute to open to constructive dialogues on energy integration and prosperity of the region.

The Technical Committee has prepared a flagship event that includes special sessions on the Caribbean Offshore and the Special Session on Venezuela "*Venezuela's Upstream to Downstream - Past, Present and Future*", oral presentations, and poster sessions that will be widely attended by academic and industry participants from the USA, Europe and Latin America.

We look forward to seeing you at the second Latin American conference hosted by the HGS/EAGE!

CONFERENCE TOPICS

The deadline for abstract submission is 21st September 2020. Please submit abstracts on the following topics:

The Geology of Latin America
- Latest insights from Mexico, the Caribbean, Central and South America.
- Conjugate Margins: cutting-edge ideas from geology and geophysics.

Seismic Imaging in E&P
- State-of-the-art methods
- Acquisition and interpretation success stories
- Challenges
- Regional insights

Applications of non-seismic Geophysical Methods
- Potential Fields: Gravity and Magnetics
- Multibeam and seabed coring
- Sea surface oil slick evaluation

Petroleum Geoscience for Conventional and Unconventional E&P
- New fields
- Key reservoirs and source rocks both offshore and onshore
- Best practices and hurdles in onshore exploration and development
- Maximizing recovery

Uncertainty Reduction Using New Techniques in Geophysics, Petrophysics, Reservoir Engineering and Reservoir Characterization.

Natural Resources and Ore Geology
- Resource development
- Present and future requirements

Environmental Sustainability and Carbon Capture & Storage: highlighting responsible development.

Machine learning present and future role in exploration through to exploitation in Latin America

IMPORTANT DATES

Call for Abstracts Closes	21st September 2020
Online Registration Deadline	23rd November2020
Second EAGE\HGS Conference	1 - 3 December 2020

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SECOND EAGE/HGS CONFERENCE ON LATIN AMERICA •


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Monday, November 9, 2020

HGS General and North American Virtual Dinner Meeting

Virtual Meeting via Zoom
6:00 –9:00 p.m.

HGS Members $15 Non-Members $35 Students $5
https://www.hgs.org/civicrm/event/info?id=2231
Registered Attendees: A confirmation email will be sent upon registration with meeting links.
Event contact: Steve Naruk – steve.naruk@gmail.com

Dr. Timothy Chisholm
Hess

The Robert E. Sheriff Lecture Series

Sponsored by the Department of Earth and Atmospheric Sciences at University of Houston and the U.H. Geoscience Alumni Association

In addition to the highly anticipated presentation by Dr. Timothy Chisholm, Dr. Tom Lapen, Chair of the Department of Earth and Atmospheric Sciences, will present an update of activities at U.H. as well as the departmental Outstanding Alumni Award. There will be a poster session early in the evening on current thesis and dissertation research of the U.H. students.

Join the meeting early to meet the next generation of geoscientists from the University of Houston!

The Robert E. Sheriff Lecture Series was initiated in 1999 by the University of Houston Geoscience Alumni Association to honor Dr. Sheriff as an educator, scholar, and proponent for the geosciences. The series has recently been co-sponsored by the Houston Geological Society.

The Sheriff Lecture mission is to

bring some of the best known geologists and geophysicists in the world to the Houston community to share ideas relevant to exploration geology and geophysics, and to showcase geoscience activity at the University of Houston.

A full list of the Student Posters will be available on the HGS Website.

R.E. Sheriff Lecture:
Hess's Journey into an Emerging Superbasin and Ultra-High Impact Exploration for an Independent E&P Company

Hess's entry into the Guyana-Suriname Basin is the highest impact exploration access in the company's history. The story is about technical capacity, innovation and risk, with a bit of luck thrown in as well. It is a story that is grounded on those brilliant minds that came before us, a complete shift in exploration strategy and a result that has entirely reshaped a mid-sized independent E&P company. In 2014 Hess Corp, after a multi-year hiatus in exploration activity, reset the company's exploration strategy to focus on the Atlantic Margins. Additionally, the evolution of decades of subsurface knowledge in the Guyana-Suriname Basin was followed by the Stabroek license coming out of Force Majeure, and then evaluation of current 2D and 3D data sets, followed by ExxonMobil and their partner opening a data room. Hess's shift in strategy and farming into the block turned out to be the classic story of right place, right time. The joint venture is made up of

HGS Joint General and North American Dinner *continued on page 13*

Iceland is the World's Leader in Geothermal Resource

By Wayne Camp

Iceland, sitting atop of the mid-Atlantic Ridge, is the world's leader in geothermal resource, most of which is used for heating. Electricity generation is the second largest use with 665 MW generation capacity, comprising 29% of the country's total electricity production, mostly consumed by aluminum manufacturing plants (**Figure 1**). Hydroelectric provides most of Iceland's electrical power (72%) with most of the water supplied by glacial meltwater.

An interesting use of geothermal is to melt snow and ice during the winter in downtown Reykjavik where an extensive network of underground piping has been installed below streets, sidewalks and parking lots.

The Krafla geothermal power plant is supplied by several wells drilled on the flank of the active Krafla volcano (**Figure 2**) overlooking Lake Myvatn in northern Iceland. Construction of the power plant began in 1974 and was interrupted several times until earthquakes and volcanic activity declined in 1984. Steaming fumaroles and burping mud pits can still be observed today.

Iceland Deep Drilling Project (IDDP)

A consortium of Icelandic power companies and the Icelandic government are drilling a series of boreholes below existing geothermal fields to test the geothermal potential of deep hydrothermal fluids at depths of 5 km (16,400 ft) with expected temperatures ranging from 450°C to 600°C (840°F-1100°F). This deeper heat source is expected to produce 10 times the electric power of a typical 5MW well drilled to 2.5 km (8,200 ft). **Figure 3** shows the IDDP drilling rig at Svartsengi geothermal field in southern Iceland.

The Blue Lagoon (**Figure 4**) is a popular tourist destination that is supplied from water discharged from the nearby Svartsengi geothermal power plant. The blue color of the water is from suspended fine silica particles, which settles on the bottom of the man-made pool. Bathers apply this soft mud to their skin and soak in the 100°F water is thought by some to have natural healing powers.

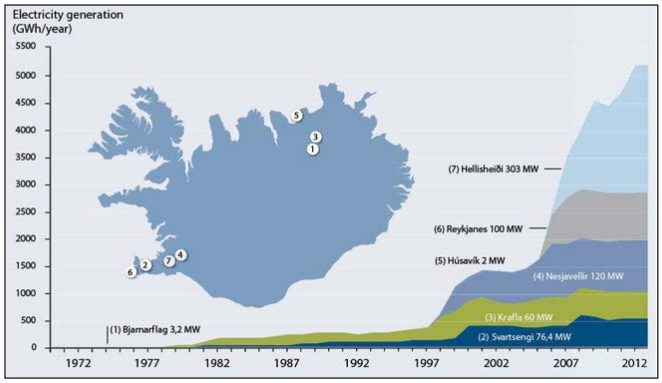


Figure 1. *Location of geothermal power plants in Iceland. Source: Orkustofnun National Energy Authority, https://nea.is/geothermal/electricity-generation/.*

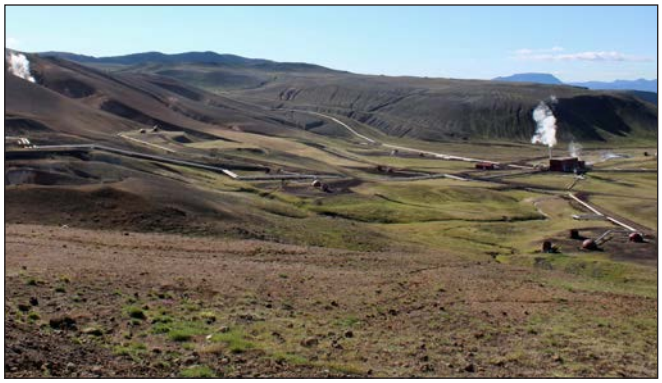


Figure 2. *Krafla 60 MW geothermal powerplant located in northern Iceland showing insulated well heads and above ground pipelines on the north flank of an active volcano.*

Figure 3. *Deep Drilling Project well located at Svartsengi geothermal field in southern Iceland.*

Figure 4. *Blue Lagoon popular tourist destination. Bathers soak in the 100°F discharge water from the Svartsengi geothermal power plant.*

HGS Joint General and North American Virtual Dinner *continued from page 11*

ExxonMobil operating at 45%, Hess at 30%, and CNOOC at 25% working interest. Exploration in Stabroek has followed a discovery trajectory of finding >8 BBOE recoverable in less than 5 years since first discovery at Liza-1 in 2015. Hess secured an early, low cost acreage position across Guyana and Suriname totaling nearly 60,000 km2 or ~1,500 GoM OCS blocks across the heart of the basin. The joint venture in Stabroek has worked continually to optimize rapid appraisal and repeatable development concepts to maximize value for all the benefiting stakeholders – with, of course, the people of Guyana being the largest interest holder! Uniquely, the development is also occurring at a time when costs are near the bottom of the market. The value therefore unlocked by this opportunity is both company changing and Country changing. It will put Guyana at the very highest production per capita in the world with a plan to produce over 750 kbopd by 2026 and much more future potential to come. This opportunity has allowed Hess to move from 4th to 1st Quartile in exploration performance since 2014 and is delivering a leading position amongst our peers in total shareholder returns. ■

Biographical Sketch

Dr. Timothy Chisholm joined Hess in 2014 as VP Exploration and is currently responsible for leading a non-operated and integrated organization across the business spectrum of exploration, appraisal, and developments in the emerging Guyana-Suriname Basin. The joint venture with ExxonMobil and Nexen/CNOOC plans to go from zero to over 750 kbopd production by 2025 in the Stabroek license. Tim is also a member of Hess's Exploration Council that acts as the decision review board for all aspects of global exploration and appraisal.

Prior to joining Hess in 2014, Chisholm was the Director of Exploration and New Ventures – Americas at Apache Corp. and prior to that was Regional Exploration Manager for Apache Egypt.

He began his career at Exxon in various technical roles, including Exploration Geophysicist and Expert Structural Geologist working the Gulf of Mexico and International New Ventures. He also spent more than a decade working for Shell in various exploration roles in the deepwater Gulf of Mexico, Northwest Borneo in Malaysia, and the Nile Delta in Egypt where his teams contributed to major oil discoveries at Gumusut, Vito, and Appomattox.

Dr. Chisholm holds a bachelor's degree in Geology with Distinction from Colorado State University and a master's degree in Geophysics with Honors from the University of Utah. His master's thesis in 1990 on inferring climate change from borehole temperature profiles led to multiple NSF grants and research that is ongoing to this day. Between degrees Tim did an internship in environmental geology with Hydrofluent in Los Angeles, CA.

Wednesday, November 16, 2020

Virtual Meeting via Zoom
6:00 –7:00 p.m.
HGS Members $15 Non-Members $35 Students $5
https://www.hgs.org/civicrm/event/info?id=2242
Registered Attendees: A confirmation email will be sent upon registration with meeting links.
Event contact: Steve Getz – slgetz@outlook.com

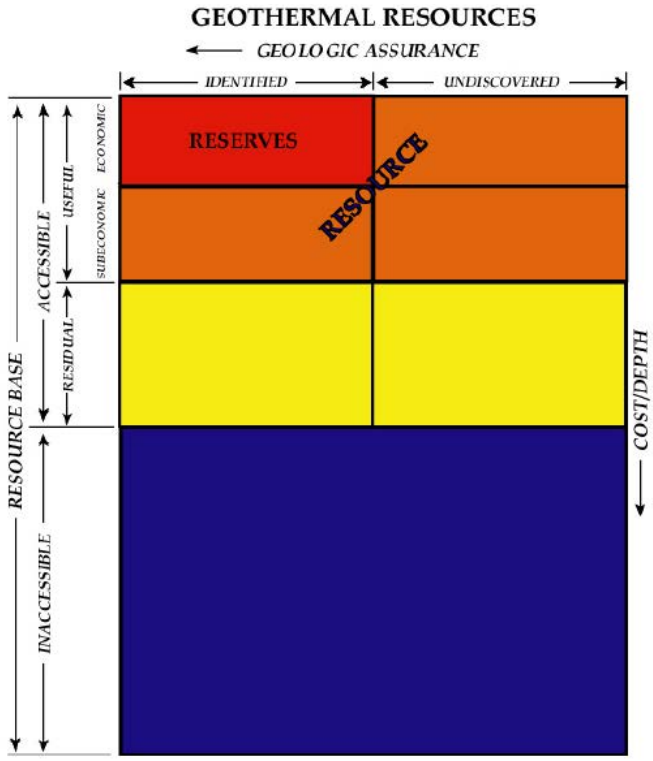
Steve Getz
Green Cloud Inc
Bob Wiener
Goh Seismic Interpretation Services and Goh Exploration, Inc.

Global Exploration for Geothermal Resources

This talk reviews the basics of geothermal energy and our role as geologists to find where it can be economically produced now and where deeper future reserves can be found.

Oil and gas exploration has had a long run since the 1973 Arab oil embargo and the 1978 Iranian Revolution. Scientific and social concerns now bring into question that drive for ever increasing hydrocarbon production. Yes, the decline curve will require consistent reserve replacement for many years, but industry concern is no longer peak oil, rather it is peak demand. One of the driving factors towards peak hydrocarbon demand is climate change.

The scientific consensus is that climate change is real, burning fossil fuels is a primary accelerant; catastrophic social and economic changes are beginning. This is driving a major push to carbon free or at least carbon neutral alternative energy sources. These include nuclear, hydro, solar, wind, biomass, hydrogen, and geothermal. Geothermal is the topic of this paper. Since geothermal can provide 24/7 baseload power and 97% up-time it is a much better renewable energy than wind or solar. It is good for the climate, good for the economy, and good for geologists. The McKelvey diagram, show here, is named after Vincent E. McKelvey (1972), a former Director of the USGS. He came up with this chart to help illustrate concepts and terminology used in resource evaluation. In this diagram the vertical axis represents the degree of feasibility of economic exploitation. The horizontal axis represents the degree of geological certainty. Has resource been discovered and is certainly there; or has it not yet been discovered but is likely to be there? The vertical axis has four divisions with increasingly favorable economics towards the top. The following resource-assessment terms are illustrated on the chart and defined as follows.



McKelvey diagram representing geothermal resource and reserve terminology in the context of geologic assurance and economic viability.

1. **Resource Base** – all the heat in the Earth's crust beneath a specified area, referenced to local mean annual temperature.

2. **Accessible Resource Base** – the thermal energy at depths shallow enough to be tapped by drilling using technology available at present or within the foreseeable future

3. **Resource** – that part of the accessible resource base that is producible given reasonable assumptions about future economic and technology.

4. **Reserve** – that part of the resource, which is identified and producible with existing technology and under present economic conditions

At present the geothermal energy industry is exploring and developing resources at the top of the McKelvey diagram, in the red and orange.

So, it is important to know where in the world these geothermal resources and reserves exist. ■

Biographical Sketches

Steven L. Getz worked nine years as a geophysicist for Cities Service Oil Company before becoming an oil and gas consultant for twenty-six years. From 1983 through 1987, he was an owner/partner of a NASD firm, wherein he held a Series 24 license. After the stock market collapsed of 1987 he resumed work as an oil and gas consultant until 2005. From 2005 through 2010 he was Chief Geologist for Allen Hoffman Exploration. Upon leaving Allen Hoffman in early 2011, he resumed work as an oil and gas consultant. He worked for Fortesa International, as well as Petrotrin the national oil company of Trinidad and Tobago. He also worked for a private landowner in the northern Gulf Coast of the USA before starting work in 2017 for Green Cloud Inc, a geothermal resource company in Reno, Nevada.

Mister Getz is the current Chairman of the HGS International Group and past chairman of the AAPG Geophysical Integration Committee. He served four terms in the AAPG House of Delegates and gave four technical papers to HGS audiences, one of which regarded the relationships between oil and deposits and over-pressured sedimentary sequences. His interests are music, poetry and martial arts.

Bob Wiener was raised in the idyllic coastal town of Narragansett, Rhode Island. He graduated from the University of Rhode Island with a BSc Geology. After stint at Core Labs, he was hired by Cities Service Company (compliments of Arab Oil Embargo). Initially he lived in Tulsa and worked on new venture projects. In 1978 he transferred to Cities International, Houston. That year he joined the HGS. After career changes and overseas positions with Conoco, Bob returned to Houston and began his independent oil and gas consulting and prospect generating company, Goh Seismic Interpretation Services and Goh Exploration, Inc. Bob has more than 40 years of diverse exploration and production experience in technical analysis, project management, project economics, and senior management levels. His focus is the integration of appropriate geophysical technology with available geological data at regional and prospect levels to develop play concepts, evaluate leases, develop and risk prospects, and get commercially successful wells drilled. He is currently applying these skill sets to geothermal energy exploration and development.

Bob was member of the AAPG Geophysical Integration Committee. He is a past Chairman of the North America Interest Group and a past Vice President of the HGS.

EARTH SCIENCE WEEK

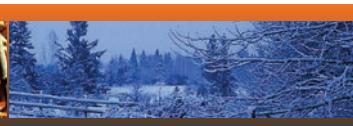
Earth Science Week 2020

Earth Science Celebration

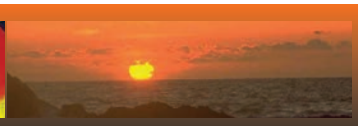
The Houston Geologic Society celebrated Earth Science Week 2020 by hosting a week-long virtual experience, Sunday, Oct. 11 through Saturday, Oct. 17. Due to COVID restrictions, we were unable to hold an in-person event at the Houston Museum of Natural Science as has been done every year since 1998. This year's theme was "Earth Materials in Our Lives". Each day focused on a different area of geoscience. The week kicked off with an AGI Earth Science Week video. Monday featured Switch Energy documentaries. Tuesday focused on AWG Geoscience Career Profiles. Wednesday's online media highlighted National Fossil Day with the Green River fossil story. Thursday's videos emphasized how minerals affect our lives. Friday featured videos from the "HGS Field Trip Friday's" series.

HGS/HMNS volunteers **Sharon Choens** and **Inda Immega** served as event Chairs. HGS/HMNS volunteers **Lynn Travis** and **Janet Combes** served as Co-Chairs, with help and advice from many of our colleagues in curating the selection of resources. Many thanks Alyssa Cushing for the great website.

November 2020



Sunday	Monday	Tuesday	Wednesday
1	2 **Virtual Pre-registered Prices:** Virtual Meetings members ..... $10/15 Emeritus/Honorary members..... $10/15 Student members ..... $5 Nonmembers $30/35	3	4
8	9 **R.E. Sheriff Lecture** **HGS General and North American Dinner** **Virtual Zoom Meeting** *"Hess's Journey into an Emerging Superbasin," Dr. Timothy Chisholm, Page 11*	10 **HGS Board Meeting** *6 p.m.*	11
15 **Houston Gem and Mineral Society** **2020 Virtual Annual Show**	16 **HGS International Dinner Virtual Zoom Meeting** *"Global Exploration for Geothermal Resources," Steve Getz and Bob Wiener, Page 14*	17	18 **HGS Continuing Education Virtual Zoom Workshop and Tour** *"Advanced Surface Logging," Presented by GEOLOG, Page 30*
22	23	24	25
29	30	**Virtual EAGE/HGS Conference on Latin America** *Page 2, 6-9*	



GeoEvents

Thursday	Friday	Saturday
5	6 **Don't wait, make your reservations online at hgs.org**	7
12	13	14 **Houston Gem and Mineral Society 2020 Virtual Annual Show**
19 **AAPG Virtual Research Symposium – Mexican Basins** **NeoGeos Virtual Trivia** *Page 18*	20	21
26 *HGS Office Closed for Thanksgiving*	27	28

Reservations:
The HGS prefers that you make your reservations on-line through the HGS website at www.hgs.org. If you have no Internet access, you can e-mail office@hgs.org, or call the office at 713-463-9476. **Reservations for HGS meetings must be made or cancelled by the date shown on the HGS Website calendar, normally that is 24 hours before hand or on the last business day before the event**. If you make your reservation on the Website or by email, an email confirmation will be sent to you. If you do not receive a confirmation, check with the Webmaster@hgs.org. Once the meals are ordered and name tags and lists are prepared, no more reservations can be added even if they are sent. **No-shows will be billed.**

December 1-3, 2020
Virtul Second EAGE/HGS Conference on Latin America
Page 12


GEO TRIVIA: ROUND 2
November 19th
5:30-7 PM
NeoGeos
HGS
Virtual trivia via Zoom and Kahoot. Instructions will be provided soon.
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1923

Geothermal Primer: Is Geothermal Gaining Steam?

By Graham Bain and Bryn Davies, Enverus

Focus

What technologies are being explored by geothermal operators? How does geothermal fit in the global energy mix?

Key Points

Geothermal power generation offers direct crossover in skills, materials and infrastructure from the oil and gas industry that can be leveraged to inject momentum into a sector that the IEA estimates could help replace 280 TWh of electricity by 2030. Developing countries will likely take up much of that development, though the U.S. currently leads in total capacity.

Primary technologies include direct-use geothermal, hydrothermal resource, enhanced geothermal systems (EGS) and advanced geothermal systems (AGS), each with their own unique benefits and constraints. Hydrothermal relies on the presence of a permeable hydrothermal reservoir and is proven to be cost competitive to other renewable resources, while EGS and AGS are the most widely scalable and can be deployed almost anywhere but are not yet cost competitive.

Direct-use geothermal is the most widely adaptable and scalable technology in the space, while geothermal for power generation still requires public and private investment to further improve the rate of innovation to meet the IEA scenario.

The global average levelized cost of electricity (LCOE) for hydrothermal geothermal power plants is $73/MWh, while EGS plants range from $109-$569/MWh depending on the geothermal gradient.

General

The market's focus on energy's carbon intensity increased precipitously in 2020. Operators like BP are taking an aggressive path and turning to renewable energy to fuel future growth. So far, solar and wind are grabbing the bulk of the market's attention due to an influx of investment and rapid innovation over the past decade. Geothermal, on the other hand, has gained substantially less attention. This primer provides an overview of the different geothermal technologies and highlights how some of the skill sets, materials and infrastructure overlap with existing O&G capabilities.

A primary benefit to adding geothermal to the renewable energy mix is that it offers predictable baseload power and is not intermittent like solar and wind. The importance of dispatchable power was highlighted this summer when California faced power shortages in early August as extreme heat caused rolling blackouts to maintain the grid. In 2019, California recorded less than 6%[1] of its electricity generation from geothermal power compared with 11% each for wind, solar and hydro plus 35% from natural gas. Geothermal power generation in the U.S. held relatively flat since 2000, moving from 0.36% to 0.39%[1] of total annual power generation (**Figure 1**).

Geothermal Primer: Is Geothermal Gaining Steam? *continued on page 20*

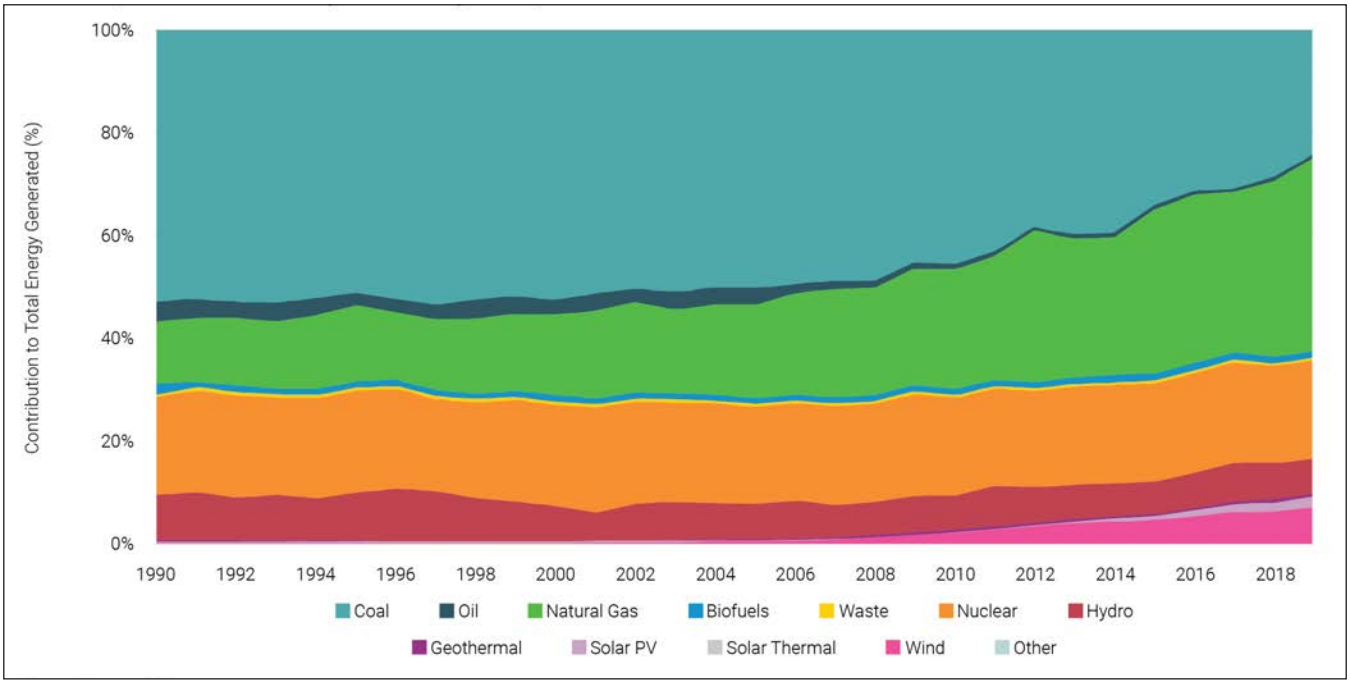

Figure 1: *United States Electricity Generation by Source, 1990-2019. Source : Enverus, IEA*[2]

Geothermal Primer: Is Geothermal Gaining Steam?

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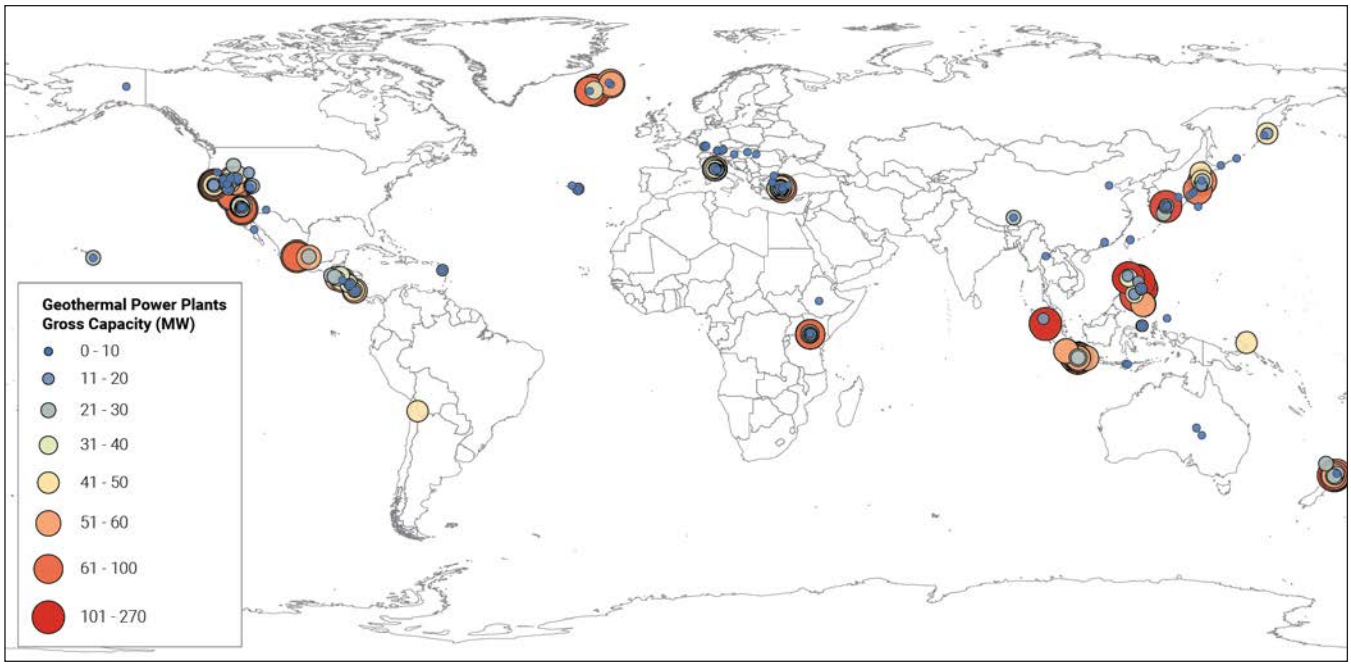

Figure 2 : *Global Geothermal Powerplants and Capacity (MW).Source: Enverus, European Commission*[5]

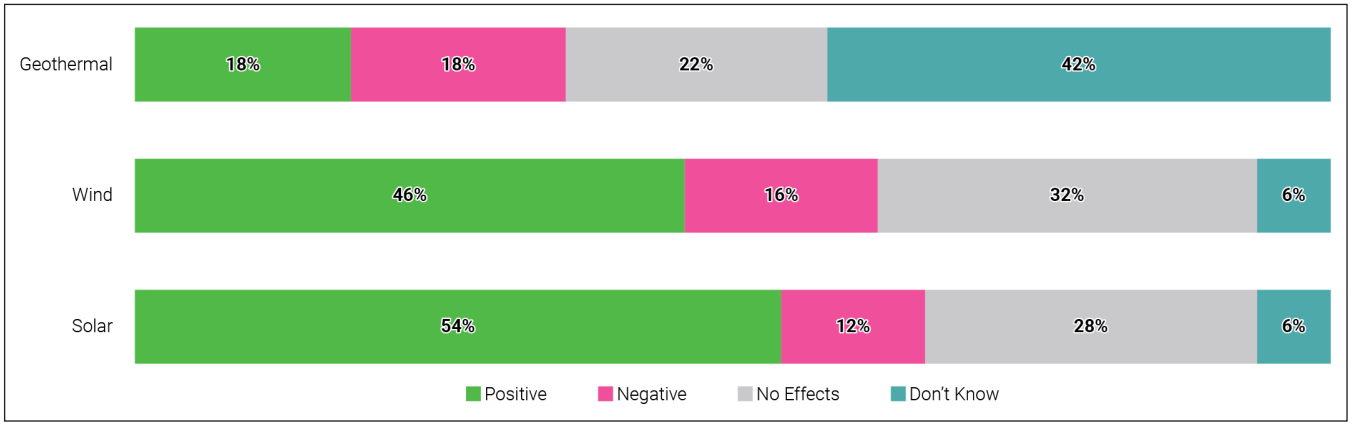

Figure 3: *Social Acceptance of Renewable Energy Technologies. Source: Enverus, Pellizzone et al, 2015*[6]

Technologies

Geothermal has slowly been gaining traction, with power generation capacity accelerating over the last five years to a rate of roughly 3% per year[3] in the United States. The Department of Energy (DOE) projects a threefold increase over the next 30 years, driven by improvements in regulator timelines and technology. Despite electrical generation from geothermal being an established technology for over 100 years[4], and many geothermal power plants actively operating globally (**Figure 2**), most of these are restricted to tectonically-active areas. Current and emerging technologies and their potential is not widely understood (**Figure 3**).

It is important to understand that the energy output and economic feasibility of geothermal resources become greater at higher temperatures (increased energy density), higher permeability (increased flow rates) and shallower depths (decreased drilling costs). We can consider five branches of geothermal technology with varying degrees of viability: direct-use, hydrothermal, enhanced geothermal systems (EGS), advanced geothermal systems (AGS) and supercritical.

Direct-Use Geothermal

This technology refers to geothermal energy used in heating or cooling, not electricity generation (**Figure 4**). Generally produced from lower temperature sources, it is one of the oldest forms of geothermal use dating back 10,000 years[7], with applications including heating and cooling of spaces through shallow geothermal heat pumps, bathing, fish farming, greenhouse heating, agriculture, snow melting and industrial (including concrete curing, water bottling, milk pasteurization and more). In the last 25 years, global megawatt thermal (MW_{th}) capacity for direct-use geothermal increased over 10-fold from 8,664 MW_{th} to 107,727 MW_{th}[8], of which

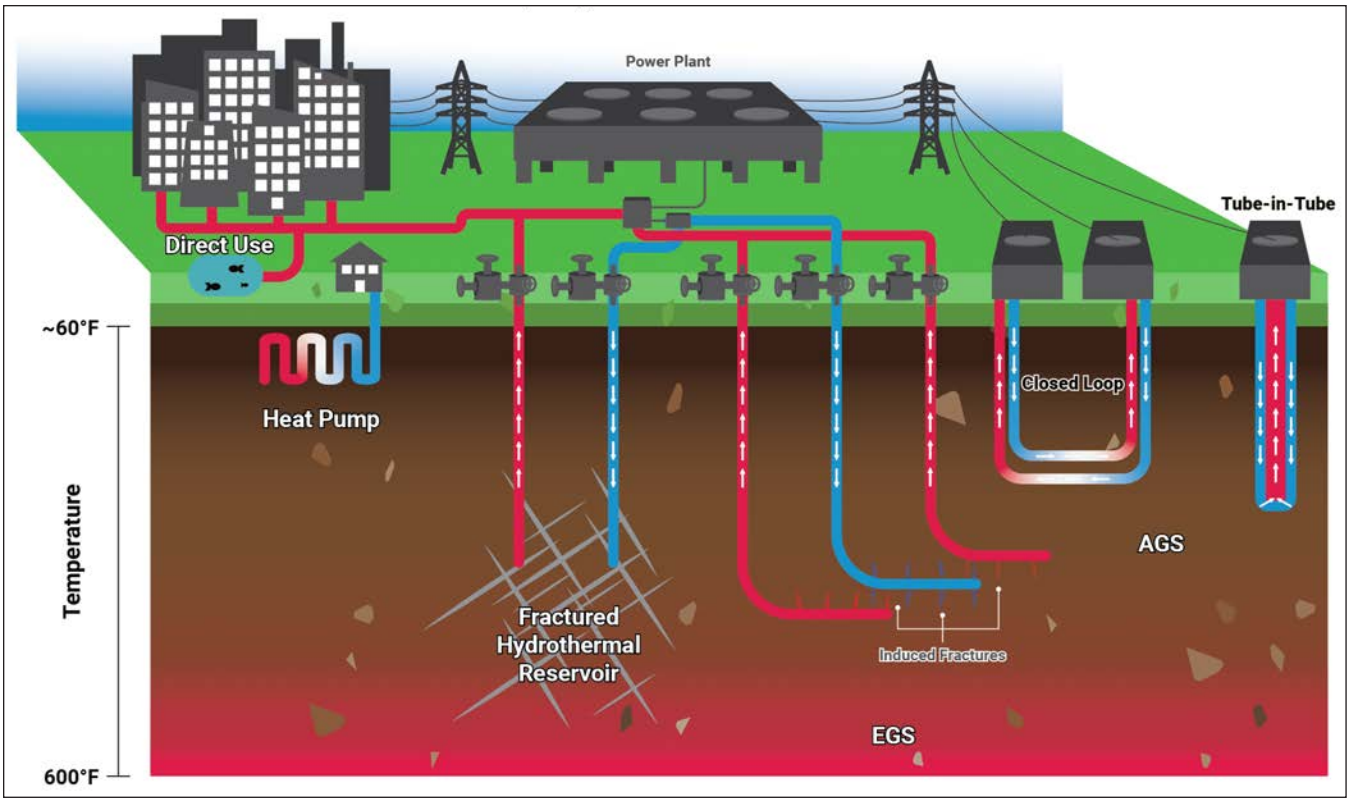

Figure 4: *Left to Right: Hydrothermal Resource Powerplant Design, EGS Power Plant Design, Tube-in-Tube Design, End-to-End Wellbore Connection Closed Loop Design. Source: Enverus, modified from USDOE[3], Hu Z., et al., 2020[21], Eavor[22]*

roughly 80%[8] comes from China, the U.S., Sweden, Germany and Turkey. As nearly 60% of energy[9] use in American homes goes towards water and space heating and cooling, direct-use geothermal can play an important role in reducing the need for electricity for these applications.

Hydrothermal Resource Geothermal

This is the "conventional" geothermal approach developed around existing subsurface hydrothermal resources in fractured permeable reservoirs (**Figure 4**). It tends to require expensive and time-consuming exploration work to find these energy sources. Once found, the hydrothermal fluid is pumped to the surface where it is used to turn a turbine to produce electricity. The fluid is then pumped back underground to maintain reservoir pressure and is reheated by the surrounding rock. One common constraint, similar to wind, solar and hydro, is that producing fields tend to be far from cities and demand centers, lowering efficiencies and requiring costly transmissions lines to be built. Recent advances in drilling technology, such as improved geosteering, and hydraulic fracturing developed for the unconventional shale boom, have provided the inspiration for new and emerging geothermal technologies that will allow for commercial production of geothermal heat from almost anywhere.

Enhanced Geothermal System (EGS)

EGS is analogous to present-day hydraulic fracturing, except instead of avoiding well pair fracture connectivity, it is encouraged. This allows for an injection well to pump cool water into the subsurface, where it is heated by the surrounding rock and migrates through induced fractures to producer wells, where the hot water is pumped to the surface and used to create electricity (**Figure 4**). EGS has a much wider geographic range than conventional geothermal. If wells can be drilled deep enough to access high-temperature rock, and induced fractures allow for high flow rates, there is no need for an existing hydrothermal reservoir. Current technologies aim to repurpose existing oil and gas wells to cut the upfront drilling costs and to reduce environmental impacts of new wells. The U.S. DOE's GeoVision initiative under the technology improvement scenario predicts 60 GWe[3] of cost-competitive geothermal capacity by 2050, the majority coming from EGS drilled below a depth of 10,000 feet.

Advanced Geothermal Systems (AGS or Closed Loop)

Closed loop geothermal, first conceived in the 1980s, is designed so that heat-conducting fluids never come in direct contact with the rock. This is done through either a tube-in-tube design or more recently, due to advances in geo-steering technology, two unconventional well bores connected end-to-end (**Figure 4**). Surface fluids are pumped down and conductively heated before returning to the surface. As the fluid is in a completely closed system, some benefits of AGS include the ability to use any heat conducting fluid[10]. This also mitigates any risk involved with

Geothermal Primer: Is Geothermal Gaining Steam? *continued on page 22*

Geothermal Primer: Is Geothermal Gaining Steam?

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water-rock interactions such as fracture mineralization or induced seismicity.

Supercritical Geothermal

The final geothermal technology is the ability to drill hydrothermal, EGS or AGS wells economically to extreme depths (typically > 10,000 ft), pressures (> 3,200 PSI) and temperatures (> 374°C)[23] where water is in a supercritical state, meaning it doesn't behave like a gas or a liquid. These fluids have very high energies, and high rates of mass transport, making them more efficient and economically attractive. Advances in drilling and surface technology will be required to make this a viable option, but if achieved, has the potential to greatly accelerate geothermal deployment, with few regional barriers.

Challenges

As with any energy project, particularly ones using new technologies, the biggest challenge facing geothermal is the economics. Capital costs for conventional hydrothermal plants are above $4,200/kW[3], while new EGS plants cost around $32,000/kW[3], the majority of which come from drilling costs at ~50%[11]. This results in a global weighted average levelized cost of electricity (LCOE) of $73/MWh for hydrothermal plants and from $109-$569/MWh[19] for EGS plants depending on the geothermal gradient. This compares to $47/MWh for hydro, $68/MWh for solar, according to the International Renewable Energy Agency[20], and $48/MWh for onshore wind, $76/MWh for fixed offshore wind, and $92/MWh for floating offshore based wind. Another hurdle is the time lag from investment to return. In 2016, hydrothermal projects in Kenya averaged seven years[12] from survey stage to commissioning.

Advances in drilling technologies[10], such as Kymera bits, HyperBlade cutters, PDC bits and plasma or laser drilling, to be fit-for-purpose for geothermal are being developed to help bring costs down. Further cost reductions will come with advancements of well corrosion control and mineral scaling issues as well as tracer technology[13] to better understand subsurface fluid migration in specific geothermal projects. Finally, a portfolio approach may help to create efficiencies as companies and drilling crews become more familiar and experienced in the area.

Geothermal also does not hold the same political backing as wind or solar, and a lack of regulatory certainty can limit investor confidence. For example, Alberta only announced in October 2020[14] a regulatory framework for geothermal energy.

Outlook

The IEA predicts that geothermal power, if implemented according to its "Sustainable Development Scenario," could add 280 TWh to the grid by 2030. However, that scenario is projected with a 10% addition of electricity generation per year; the current rate is 3%[17].

Innovation from across the world in these different technological sectors is showing an upward trend in results, and developing countries are especially looking to renewable sources of electricity to support growth. For example, roughly 45% of Kenya's electricity is sourced from geothermal as the country is leveraging its geographic exposure to shallow heat along the East Africa Rift Valley. The industry in Kenya has doubled its growth since 2013, when there was a surge in both public and private funding. In 2018, one third of the $1.4 billion investments in renewables ($486 million) were directed toward geothermal[15]. Nearby countries including Ethiopia, Zambia, Djibouti, Tanzania and Uganda are all in partnership discussions to adopt geothermal following the Kenyan projects.

Many small-scale geothermal projects contributed 0.2% of the European Union's electricity, from developments in Switzerland, the Netherlands, Norway, Germany, France and Italy[17]. Additionally, the U.K. has had some developments in technology, such as transitioning coal plants in Glasgow and investigating the potential of fluids in granites in Cornwall[17].

In the U.S., the DOE awarded $28 million for geothermal research in 2019 to five different projects across the country[16]. Nevada and California have the most installed geothermal electricity capacity of the total 3.7 GW[18]. In Canada, there are several projects in the western provinces testing geothermal for electricity. The country doesn't currently produce any electricity from geothermal, it is solely used in direct heating to buildings.

Although geothermal has not had the same widespread adoption compared to other renewable technologies, meaningful strides have been made globally in advancing the resource. Direct-use geothermal for heat is the most applicable today. The application to disrupting the electricity sector is limited by geographical location from hydrothermal resources, while EGS and AGS are not yet cost competitive to other renewables such as wind and solar. With a focus on cost reductions and leveraging the crossover with the oil and gas sector, geothermal anywhere has the potential to become a viable option as a sustainable baseload solution to balance the power load in the increasing intermittent renewable energy mix. ■

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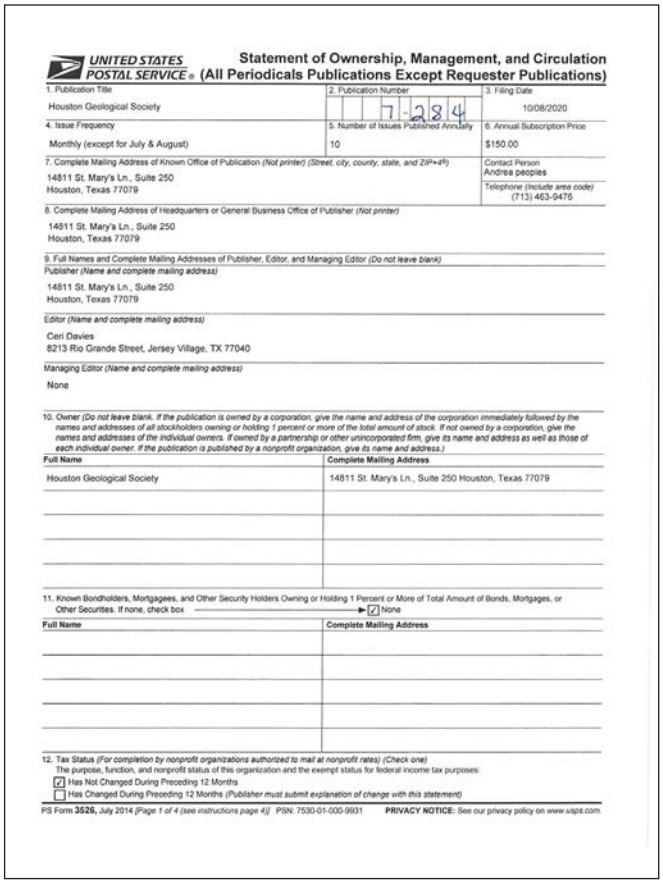

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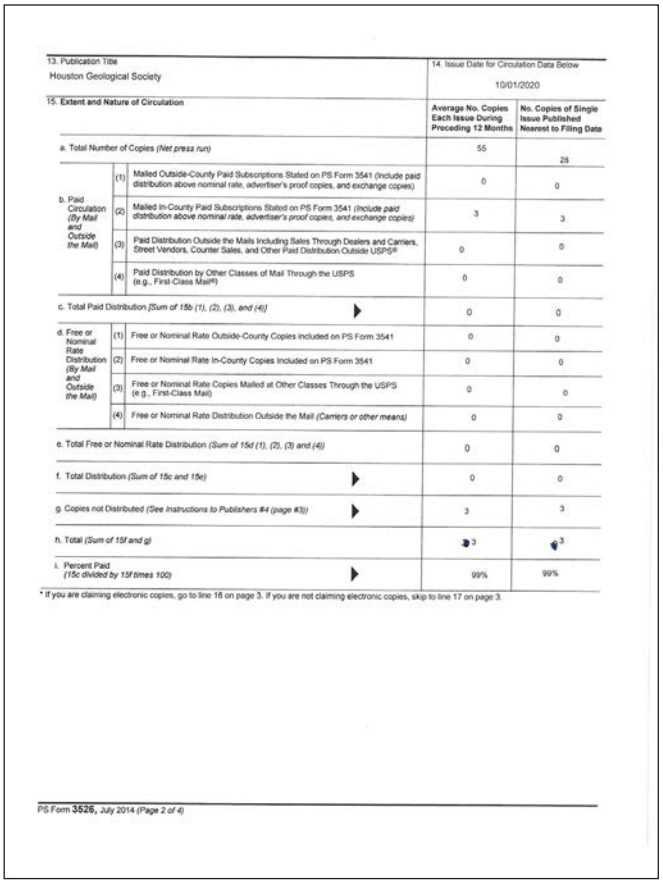

13. Publication Title: Houston Geological Society
14. Issue Date for Circulation Data Below: 10/01/2020

15. Extent and Nature of Circulation			Average No. Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest to Filing Date
a. Total Number of Copies *(Net press run)*			55	28
b. Paid Circulation *(By Mail and Outside the Mail)*	(1)	Mailed Outside-County Paid Subscriptions Stated on PS Form 3541 *(Include paid distribution above nominal rate, advertiser's proof copies, and exchange copies)*	0	0
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f. Total Distribution *(Sum of 15c and 15e)* ▶			0	0
g. Copies not Distributed *(See Instructions to Publishers #4 (page #3))* ▶			3	3
h. Total *(Sum of 15f and g)*			3	3
i. Percent Paid *(15c divided by 15f times 100)* ▶			99%	99%

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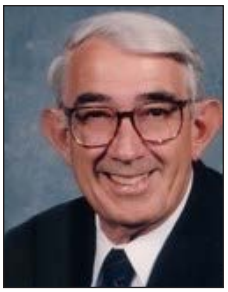
Remembrance

James C. Patterson
1929-2020



James C. "Jim" Patterson passed away on September 29, 2020 in Houston Texas after complications due to kidney issues. Jim was born May 8, 1929 in Oxford, Arkansas, to Davis S and Vera M Patterson. He is survived by son Mark Patterson, and daughter in law Laura Patterson of Houston Texas; daughter Nancy Patterson of New Orleans Louisiana; son in law Ben Cleary and grandson Alexander Cleary of Mechanicsville Virginia and many more nieces, nephews and friends. He was preceded in death by his wife Marjorie and daughter Catherine Cleary.

Jim attended primary and secondary school in Jonesboro and Little Rock Arkansas. He graduated in 1947 from Little Rock senior high school. While in high school he worked part time for Southwestern Bell Telephone Company earning money to take flying lessons. He obtained his private license at age 16. Aviation was a lifetime interest. Following high school graduation, he began studies at Little Rock Junior College transferring to the University of Arkansas at Fayetteville, where he received a Bachelor of Science degree in zoology and chemistry in1950.

When the Korean war started June 25, 1950, Jim received notice from his draft board to report for duty. He trained for 13 weeks at Chaffee Arkansas and Fort Sill Oklahoma before he shipped out for Korea. He was subsequently assigned to the 64th field hospital in Pusan as a chief medical laboratory technician, a position he held until his honorable separation on December 30, 1952.

Military service now completed, he traveled to Dallas, Texas and was immediately hired by National Geophysical Company (NGC) to work on seismic crews. In May 1954 he accepted a job with Continental Oil Company again working on seismic crews. While working for Continental later "Conoco". He developed a passion for geology and geophysics. He loved the challenge of the search for hydrocarbons. Jim worked 37 years for Conoco retiring in October 1991 as vice president for Exploration and Production North America.

Jim's job with NGC brought him to Rawlins Wyoming in 1953 where he met and married Marjorie Davis, his wife for 57 years. They moved frequently living in Los Angeles, New York, and many places in between. In 1969 Jim received a promotion and moved to London England with his family. The family took many fun vacations around Europe during this time. Jim had many interesting stories of his work travels to the Middle East, Africa and Europe. The family lived overseas for about 12 years with residences in London, England, and Cairo, Egypt. These were exciting times, made even more so by the many close friends they made in diverse parts of the world.

Jim and Marjorie enjoyed their retirement years. He renewed his private pilot's license, purchasing a Cessna, he enjoyed time spent in the hanger he built at the west Houston airport and flying. They traveled extensively. During the summer, Marge and Jim escaped the Houston heat at their home in Dillon, Colorado indulging in long mountain hikes and fishing adventures. For the past 8 years Jim has resided at the Buckingham retirement home in Houston where he made a lot of friends. He was active in the men's book club and bible studies.

Jim was a member of numerous professional organizations including the SEG, AAPG "Associate Member", GSH, HGS and the University of Texas (UT) Geology Foundation Advisory Council where he served as chairman for 2 years. He established the James C. Patterson endowment fund for excellence in the geophysical sciences at UT. Jim joined HGS in April 1984.

Jim will be remembered as a devoted husband and family man who spent many quality years helping raise his children. Jim was a man of faith and hope being a lifelong member of the Church of Christ. The memories he gave his family will last forever and he will be greatly missed. ■

Summarized from the Life Tributes section of the *Houston Chronicle on* October 2, 2020,

Remembrance

John F. Simpson
1929-2020

John Francis Simpson, 90, passed away peacefully on September 20, 2020 of natural causes.

Born in 1929 to Ellen and John Simpson, John attended Shaw High School before enrolling at Western Reserve University in Cleveland, Ohio. Shortly after graduating in 1951 with a Bachelor of Science in Geology, John enlisted in the U.S. Army. He spent nine months and nine days in the combat zone of Korea, where his assignment was Company Commander with the rank of First Lieutenant. After being honorably discharged, John was awarded the National Defense Service Medal and the Korean Conflict Service Medal by the U.S. Army, the United Nations Korean Service Medal by the United Nations, and the Ambassador for Peace Medal by the Government of South Korea.

Over the course of his life John moved through different lines of work, including teaching night classes on geology at the University of Akron, publishing studies on the origin of the Moon as a geophysicist with Goodyear Aerospace Corporation, researching for the U.S. Securities and Exchange Commission, and prospecting for natural gas, which brought him to all corners of the United States as well as to Colombia. John joined HGS in January, 1981.

John was a lover of animals and nature, traveling with his family to destinations as varied as the Galapagos Islands, Serengeti National Park in Tanzania, and the Amazonian River Basin in order to appreciate their natural beauty. He visited the U.S. National Parks well into his late eighties, as it brought him great joy to see the wildlife. When at home, John diligently fed the birds and squirrels in the backyard so that he could enjoy their company while he read the newspaper each morning.

John was preceded in death by his parents and son, Jack Martin Simpson. He is survived by his wife of 34 years, Maria Theresa Simpson; his children Eileen Susan Billiris, Elizabeth Louise Howard, and Sidney Harrison Simpson; four grandchildren and six great-grandchildren. ■

Summarized from the Life Tributes section of the *Houston Chronicle on* September 30, 2020,

HGS *Bulletin* Instructions to Authors

All materials are due by the 15th of the month, 6 weeks before issue publication. Abstracts should be 500 words or less; extended abstracts up to 1000 words; articles can be any length but brevity is preferred as we have a physical page limit within our current publishing contract. All submissions are subject to editorial review and revision.

Text should be submitted by email as an attached text or Word file or on a clearly labeled CD in Word format with a hard copy printout to the Editor.

Figures, maps, diagrams, etc., should be digital files using Adobe Illustrator or Adobe Photoshop. Files should be saved and submitted in .ai, .eps, .tif or .jpg format. Send them as separate attachments via email or CD if they are larger than 5 MEGs each, accompanied by figure captions that include the file name of the desired image. DO NOT EMBED them into your text document; they must be sent as separate files from the text. DO NOT USE POWERPOINT, CLIP ART or Internet images (72-DPI resolution) as these do not have adequate resolution for the printed page and cannot be accepted. All digital files must have 300-DPI resolution or greater at the approximate size the figure will be printed.

Photographs may be digital or hard copy. Hard copies must be printed on glossy paper with the author's name, photo or figure number and caption on the back. Digital files must be submitted in .tif, .jpg or .eps format with 300-DPI or greater resolution at the printing size and be accompanied by figure captions that are linked by the file name of the image. The images should be submitted as individual email attachments (if less than 5 MB) or on CD or DVD.

HGS *Bulletin* Advertising

The *Bulletin* is printed digitally using InDesign. Call the HGS office for availability of ad space and for digital guidelines and necessary forms or email ads@hgs.org. Advertising is accepted on a space-available basis. **Deadline for submitting material is 6 weeks prior to the first of the month in which the ad appears.**

Random Inside Ad Placement Black & White Prices Shown – Color add 30% to prices below					**Specific Page Color Ad Placement**					
No. of Issues	Random Eighth Page	Random Quarter Page	Random Half Page	Random Full Page	Inside Front Cover Full Page	Inside Back Cover Full Page	Page 2 Full Page	Outside Back Cover Half Page	Back of Calendar Full Page	Calendar Quarter Page
10	$950	$1,350	$2,550	$4,750	$8,000	$7,500	$7,050	$6,850	$6,650	$3,000
9	$800	$1,300	$2,500	$4,700						
8	$750	$1,250	$2,250	$4,300						
7	$600	$1,100	$2,200	$3,850						
6	$550	$950	$1,800	$3,500						$2,000
5	$500	$800	$1,600	$3,000	$4,700	$4,500	$4,350	$4,000		
4	$450	$650	$1,300	$2,500						
3	$300	$550	$950	$2,000						$1,000
2	$250	$400	$700	$1,500						
1	$150	$250	$450	$1,000	$1,500	$1,400	$1,250	$1,000	$1,250	$850

Professional Directory Section Business Card Ad: 10 Issues – $160 ($30 for each additional name on same card)

Website Advertising Opportunities

There are currently 5 opportunities to help spread the word about your business or event and generate traffic to your website or campaign. Please submit all ad materials five (5) days prior to the go-live date for testing.

Placement	Rate	Specifications/Description
HGS Website Home Page Banner Ad	$800 – Monthly $1800 – 3 Months $2800 – 6 Months $3600 – 12 Months	275 x 875 pixels; home page top banner ad. All Home Page Banner Ads rotate every 10 seconds.
HGS Website Home Page Column Ad	$700 – Monthly $1500 – 3 Months $2400 – 6 Months $3600 – 12 Months	200 x 400 pixels; home page right column ad
HGS Website Event Page Ad	$600 – Monthly $1200 – 3 Months $1600 – 6 Months $2600 – 12 Months	200 x 400 pixels; calendar page left column ad. All Event Page Ads rotate every 10 seconds.
Geo-Jobs	$50 – 14 days $100 – 30 days $300 – 3 Months $600 – 6 Months $1200 – 12 Months	Posting of job opportunities on HGS website. Click the Geo-Jobs tab to get started. Must be filled out completed and the dates set appropriately.
Vendor Corner	$250 *4 Pack option with 1 FREE bonus event for $1000.00 available. Send request to vendorcorner@hgs.org.	Company logo, company website, and company description will be highlighted on HGS Calendar website event. This is an opportunity to display company wares, gain personnel exposure and hand out product information at HGS dinner meetings.
Event/Short Course Calendar Ad	$100 – Monthly	An event ad posted within the HGS website calendar under the Events tab.
Bundle & Save!	• 30% off website ads when combined with print ads in all 10 HGS *Bulletin* issues. • 20% off website ads when combined with print ads in 5 HGS *Bulletin* issues. • 10% off website ads when combined with print ads in 3 *Bulletin* issues.	

Application to Become a Member of the Houston Geological Society

Qualifications for Active Membership

1) Have a degree in geology or an allied geoscience from an accredited college or university; or
2) Have a degree in science or engineering from an accredited college or university and have been engaged in the professional study or practice of earth science for at least five (5) years.

Qualifications for Associate Membership (including students)

1) Be involved in the application of the earth or allied sciences.
2) Be a full-time student enrolled in geology or in the related sciences.

Apply online at www.hgs.org and click on Join HGS

Annual Dues Expire Each June 30. (Late renewals – $5 re-instatement fee)

Annual dues are $30.00; emeritus members pay $15.00; students are free.

Mail this application and payment to:

Houston Geological Society

14811 St. Mary's Lane, Suite 250 • Houston, TX 77079-2916

Telephone: 713-463-9476 Fax: 281-679-5504

Payment method:

❑ Check, ❑ VISA, ❑ MasterCard, ❑ American Express, ❑ Discover

Card # _____

Expiration Date: _____ Card I.D. _____

(Card I.D. – 3 or 4 digit number on front or back of card)

To the Executive Board: I hereby apply for ❑ Active or ❑ Associate membership in the Houston Geological Society and pledge to abide by its Constitution and Bylaws. ❑ Check here if a full-time student.

Name: _____

Address: _____

_____

Home Phone: _____ ***Spouse's Name:*** _____

Email: _____

Job Title: _____

Company: _____

Company Address: _____

_____

Work Phone: _____ ***Fax Number:*** _____

Circle Preferred Mailing Address: Home Office

Professional Affiliations: _____

❑ AAPG member No.: _____

Professional Interest:

❑ Environmental Geology ❑ North American E&P (other than Gulf Coast)

❑ International E&P ❑ Gulf Coast E&P (onshore & offshore)

School _____

Degree _____ ***Major*** _____ ***Year*** _____

_____

School _____

Degree _____ ***Major*** _____ ***Year*** _____

Earth Science Work Experience _____

_____

_____

_____

Applicant's Signature _____ ***Date*** _____

Endorsement by HGS member (not required if active AAPG member)

Name: _____

Signature _____ ***Date*** _____

Membership Chairman _____ ***HGS Secretary*** _____

revised 5/02/17

Professional **Directory**

The Houston Geological Society Continuing Education Committee Presents

Advanced Surface Logging

A 4 Hour Virtual Technical Workshop and Tour
By Managers, Product Champions and Domain Experts of GEOLOG
Wednesday Morning, November 18, 2020 8 AM – 1 PM CST

Please make your reservations on-line through the Houston Geological Society website www.hgs.org
On-line registration at www.hgs.org will close Tuesday, November 17 at 4:00 pm.
Meeting links will be sent at this time to the email used at registration.

For more information about this event, contact HGS Office 713-463-9476 • office@hgs.org

GEOLOG
Surface Logging Services
Drilling Solutions
Lab Studies
Innovation Hub

Course Description

Wellsite surface logging while drilling has always provided early and significant insights into drilling issues, reservoir geology, rock properties and hydrocarbon type and saturations.

This workshop will bring the attendees up to date with the latest academic, and case-studies from the field, of the advanced surface logging technologies. The course will cover:

- Basics of Surface Logging for Formation Evaluation while Drilling
- Reservoir Characterization from Advanced Mud Gas Logging
- Real-time Isotopic Analysis δ13C of C1 , C2 and C3
- Source Rock Characterization
- Inorganic Geochemistry of Rocks
- Headspace and Interstitial Gas Measurements and Analysis
- Bit-Wear Analysis δ Fracture Analysis from Advanced Flow Measurements – Tools and Techniques for Wellbore Stability and Cleaning
- Drilling Optimization

Presenters

Andres Matheson – North America Region Manager

Isaac Easow – North America Domain Champion for Formation Evaluation

Filippo Casali – Domain Expert for Inorganic Geochemistry

Alberto Martocchia – Product Champion, Drilling Support Services

Ettore Carcione – Gas Product Champion and Quality Assurance Manager

Placido Franco, PhD – R&D team of GEOLOG-GeoTech

Pricing

Attendees will receive a Certificate of Continuing Education for 4 hrs PDH
HGS members $30
Non-members $60*
HGS Student Members $25
**Non-Members can submit an application and pay their dues before registering to get the member price. Please call the HGS office at 713-463-9476 to be registered only AFTER your application and dues are submitted.*

8:00-8:10 AM	**Welcome, Introduction and Safety Moment:** North America Region Manager
8:10-9:10 AM	**Fundamentals of Surface Logging:** 1. Surface Logging Process, Primary Well Control and Well Monitoring 2. Mud Gas Extraction and Gas Chromatography Measurements 3. Drill Cuttings Geological Descriptions and Show Evaluations 4. Geochemistry on Drill Cuttings with XRD-XRF-TOC and Source Rock Analysis
Various Global Experts	
9:10-10:10 AM	**Fracture Analysis for Reservoir Characterization & Formation Evaluation from Advanced Surface Logging**: Presenter 1: Drilling and Technology Manager Presenter 2: Product Champion/Quality Assurance Manager
10:10-10:20 AM	**Coffee Break and Continued Discussions**
10:20-10:50 AM	**GEOLOG Geotech Laboratory GEOTube Collection Process and Deliverables:** GeoTech Global Product Champion
10:50-11:50 AM	**Virtual Tour of Units/Lab/CVD with MTC**
11:50 AM-12:20 PM	**Advanced Mud Logging and Interpretation Techniques with Case Studies from USA and International Projects** North America Advanced Service Champion
12:20-12:30 PM	**Question and Answer Session**

GEOLOG

Geolog International (GEOLOG) is a world leader in oilfield services delivering solutions and expertise to national, international and independent oil, gas and geothermal operators globally. Since its founding in Milan, Italy in 1982, GEOLOG has developed effective and cost-effective alternative solutions to complex and expensive downhole measurement tools. Through the optimization of formation, fluid and reservoir analysis, well construction is improved, well delivery optimized and production delivery accelerated. By utilizing these in or near real-time rigsite applications, operators are able to mitigate risk and reduce cost. As part of its strategy to become the global supplier of choice, GEOLOG has gained experience in over 70 countries worldwide, performing services and assisting operators onshore and offshore, during exploration, development and appraisal programs in shallow to ultra-deep water, HP/HT, unconventional oil and gas and geothermal wells.

Biographical Sketches

Ettore Carcione joined the oil & gas industry in 1989 as well site logging geologist for Geoservices (France), after completing his Masters in geology at the University of Catania (Italy). He has worked as a well site-logging engineer in several countries in Europe, Asia, Africa and Latin America particularly focused on the development of gas equipment and interpretation methods. He was an instructor for well site advanced gas logging specialist within the Technical Department in France. In 1998 he joined OMV as consulting well site geologist and successively (2007) joined the Global Operations Geology Group as staff geologist with the main duty of coordinating the Global WSG activity of the company; As part of the Well Engineering Department he has been responsible of the Geological Work Program optimization and actively monitoring mud logging activity through a RTOC (Real Time Operation Monitoring). Ettore Joined GEOLOG in 2015 as gas specialist and special project coordinator in the R&D Department. Currently, he is gas product champion and quality assurance manager within the Surface Formation Evaluation and Reservoir Optimization Team.

Isaac Easow joined the oil & gas industry in 1991 as a well-site logging geologist after completing his Masters in Geology from University of Mumbai, India. He worked as a field engineer in various oilfield drilling locations in India, SE Asia, Middle East and Africa as a well-site logging geologist, gas while drilling specialist and formation pressure evaluation engineer. Since 2006 he joined the formation evaluation team to support real-time drilling monitoring and operations in North America, Latin America and West Africa. Since 2011 he has focused on interpretation and operations support for conventionals and unconventionals in North America as a domain champion for formation evaluation providing technical support and real-time reservoir characterization services, based in Houston, Texas. Currently, Isaac is active in promoting and executing reservoir characterization services utilizing advanced surface logging, organic and inorganic geochemical techniques for projects in U.S. onshore and offshore.

Andres Matheson has 23 years experience in the oil & gas industry; after completing his degree in mining engineering at the Technical University of Nova Scotia, he worked as wireline field engineer in Canada and the USA for BPB/Reeves Wireline. He later moved on to becoming a district area wireline manager before moving into a role for wireline technical sales in 2001. The company later was acquired by Precision Drilling and then Weatherford where he continued his role in technical sales. After the acquisition of Datalog Surface Logging, Andres became the Canadian Region Unit manager for Weatherford SLS looking after both Western Canada and Newfoundland operations. In 2011 he became the North America Region Unit manager for surface logging before moving back to Canada and taking over a new role as the Canadian sales and marketing manager. In 2014 he joined GEOLOG and moved to Milan, Italy to take on the role of global sales and marketing manager. As the expansion of the North America market started to grow Andres brought his previous North America experience with him to return to the USA and take over the role of North America Region manager since 2016.

Alberto Martocchia has 17 years experience in the oil & gas industry; after completing his Master Degree in Geology at the University of Milano Bicocca in Italy, he worked as mud logger and data engineer in Italy and Libya. In 2007 he moved to Tripoli Base (Libya) where he has been assigned initially as base technician, moving to the Operation Department and a country manager. In 2011, he joined the Drilling Team in GEOLOG headquarters in Milan, Italy as the product champion supporting the global deployment and delivery of drilling support services. He has extensive experience with flow meter installations including working in shipyards in South Korea and Singapore and designing surface lines during the construction of drilling ships and jack-up.

Placido Franco graduated in organic chemistry at the University of Bologna and got a PhD in analytical chemistry at the same University. During the PhD he specialized in the use of chromatography and mass spectrometry techniques for the analysis and characterization of complex mixtures. He joined the R&D team of GEOLOG-GeoTech (Milan) on May 2018 with the role of R&D scientist. He is involved in the development and optimization of new analytical instruments for field deployment, as well as the development and application of laboratory methods aimed to improved reservoir characterization by means of geochemical tools. His activity focuses also on interpretation and operational support, both in conventional and unconventional. He is co-author of 10 published articles in peer-reviewed journals, as well as contributor to a number of national and international congresses. He was also member of the directorial board of the Young Group of the Italian Chemical Society as representative of the Analytical Chemistry Division.

Filippo Casali has been with GEOLOG Srl for 5 years, where he started as field engineer and wellsite geochemistry specialist. Then joined the R&D department, following the advanced surface logging data acquisition and interpretation. Today he is the domain expert for inorganic geochemistry. He obtained his BSc and MSc in applied geological sciences at the University of Pavia, Italy.

HOUSTON
GEOLOGICAL SOCIETY
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