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High Temperature and Pressure Tools and Services for Geothermal Borehole Characterisation

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INTRODUCTION

Increasing needs and interests arise on extremely high temperature resources from supercritical or ductile regions. Some countries with volcanic activities have been running such projects, such as IDDP and DEEPEGS projects in Iceland, the DESCRAMBLE project in Italy, JBBP project in Japan, and HADES and the GNG projects in New Zealand. Exploitation of such superhot geothermal systems demands novel downhole logging tools, which can provide valuable information on the formation properties, enable inspection of a well completion, and assist in reservoir characterisation.

Most borehole measurement and logging technologies used in the geothermal sector came basically from the oil industry. But higher capability or innovative technologies need to be developed to be applied in the very demanding superhot geothermal environment.

The Task A2 “Measurement and Logging”, set up under Working Group 13 “Emerging Geothermal Technologies” of IEA Geothermal TCP (https://www.iea-gia.org/) undertook to collect and share information on high temperature and high pressure (HTHP) logging tools, including information from service companies and their tool services around the world. On-going tool development projects was another interest of the authors, with the idea that this might help people understand how the technology is being advanced.

The data are summarised in a Google Sheet and can be found through this URL

https://docs.google.com/spreadsheets/d/18idG0nPOyrE0Br5_pf62MBLqituFRDDILPIVB29tTUs/edit?usp=sharing

IT CARRIES...

This report summarises the geophysical and other logging tools and service companies worldwide in a Google Sheet. The data in the Google Sheet has a focus on tools that can be used in HTHP environments. It is divided into three separate tabs; ‘Service Companies’, ‘Tools and services’, and ‘Tool Development projects’. The data in the sheets was up to date as of October 2024.

In the **‘Service Companies’** tab is a list of companies, with their contact information, that can provide HTHP logging tools and services worldwide. Note that this is an incomplete listing, but it includes the list of companies provided by the IEA Geothermal participating member countries; Korea, Japan, Germany, New Zealand, USA, UK, Switzerland, and France.

In the **‘Tools and services’** tab is a list of HTHP tools and products from each of companies and institutions listed in the ‘Service Company’ sheet. It also provides the manufacturer, temperature and pressure rating (maximum operating temperature and pressure) of each sonde or tool.

In the **‘Tool Development projects’** tab, several projects related to developing HTHP logging tools and resultant products are listed with some references and websites. Most of those projects have concluded as of October 2024.

RESULTS

1) Service Companies

National	Company/Organisation	Service	Manufacture	Contact person	website
Korea	Korea Institute of Geoscience and Mineral Resources (KIGAM)	Yes	No		http://www.kigam.re.kr/
Japan	Geothermal Energy Research and Developement Co. (GERD)	Yes	Yes	M.Hyodo; hyodo@gerd.co.jp	https://www2.gerd.co.jp/en/business/
	Nittetsu Mining Consutlants Co., Ltd.	Yes	No	Naomi Matsumoto; chintsu@nmconsults.co.jp, +81	https://www.nmconsults.co.jp
Germany	Antares	Yes	Yes		http://www.antares-geo.de/
	GTC (Solexperts GmbH)	Yes	Yes	axel.fabritius@gtc-solexperts.com	https://www.solexperts.com/en/brands/gtc-kappelmeyer
	MeSy (Solexperts GmbH)	Yes	Yes	gerd.klee@mesy-solexperts.com	https://www.solexperts.com/en/brands/mesy
New Zealand	HADES (Hotter And Deeper Exploration Services)	Yes	No		http://www.hadessystems.com/
	MBCentury Drilling & Energy Services	Yes	Yes		https://www.mbcentury.com/services
	Western Energy Services	Yes	No		https://www.westernenergy.co.nz/
USA	Bakers and Hughes	Yes	Yes		https://www.bakerhughes.com/
	GE Oil and Gas	Yes	Yes		https://www.geoilandgas.com/
	Tiger Energy services	Yes	No		http://tigerenergyservices.com/
	Mount Sopris Instruments (MSI)	No	Yes		https://mountsopris.com/
Luxembourg	Advanced Logic Technology (ALT)	No	Yes		https://www.alt.lu/
UK	Probe	Yes	Yes		https://www.probe1.com/
	Robertson Geologging (RG)	Yes	Yes		https://www.robertson-geo.com/
	Severn Subsea Technologies (Calidus Engineering)	No	Yes		http://www.severnst.com/ http://www.calidusengineering.com
Canada	Terraplus	Yes	Yes		http://www.terraplus.ca/
Switzerland	Solexperts AG	Yes	Yes	Thomas.trick@solexperts.com Karam.Kontar@Solexperts.com	https://www.solexperts.com/en/home
France	Schlumberger	Yes	Yes		http://www.slb.com/
	FLODIM	Yes			https://www.flodim.fr/
	Solexperts SARL	Yes	Yes	mederic.piedevache@solexperts.fr	https://www.solexperts.com/en/brands/solexperts-france

2) Tools and services

Probe	Sonde/Product	Measuring property	T.max(°C)	P.max (Mpa)
	Production logging tool PTX – Slim PL Suite – 1 3/8 in.	3-Arm Caliper	177°C	138 MPa
		Casing Collar Locator	177°C	138 MPa
		Compensated Neutron Tool - PTX - 2 3/4 in.	177°C (4hrs)	138 MPa
		Gamma Ray – CCL – Neutron – Inclinometer – Temp – PTX – 1 11/16 in.	177°C (4hrs)	138 MPa
		Combined Capacitance, Flow Electronics & Temperature Tool – HD – 1 3/8 in.	177°C	68.9 MPa
		Combined Capacitance, Flow Electronics & Temperature Tool – HD – 1 11/16 in.	177°C	103.4 MPa
		Dual Axis Inclinometer – HD – 1 11/16 in.	177°C	103.4 MPa
		Fast Response Temperature – HD – 1 11/16 in.	177°C	103.4 MPa
		Fixed Cage Spinner Mechanical – HD – 1 11/16 in.	177°C	103.4 MPa
		Fluid Density Tool – HD – 1 11/16 in.	177°C	103.4 MPa
		Full Bore Spinner Mechanical – HD – 1 11/16 in.	177°C	103.4 MPa
		PTS & Casing Collar Locator – HD & PTX – Slim PL Suite – 1 3/8 in.	177°C	103.4 MPa
		XY Caliper Tool – HD – 1 11/16 in.	177°C	103.4 MPa
		Spectral Gamma Ray & CCL Tool – HD – 2 3/4 in.	177°C	103.4 MPa
Kuster_Probe	ProTherma™ Geothermal PTS	Pressure/Temperature/spinner	350°C(4hrs), 300°C(6hrs)	120 Mpa
	Quantum™ Geothermal PTS Gauge	Pressure/Temperature/spinner	350°C(4hrs)	58.6 Mpa
	Ultra-High Temperature Dimension™ X-Y Caliper	Caliper (2 direction)	325°C	58.6 Mpa

SLB(Schlumberger)	Sonde/Product	Measuring property	T.max(°C)	P.max (Mpa)	Manufacturer
	HIT, QAIT	Array induction image tools	260	207	SLB
	ARI	Azimuthal resistivity imager	177	138	SLB
	HRIA	High resolution laterolog array	150	103	SLB
	MicroSFL	Spherically focused resistivity tool	177	138	SLB
	Microlog	Micro-inverse, normal	177	138	SLB
	CHFR-plus and CHFR Slim	Cased hole formation resistivity tool	150	103	SLB
	EPT	Electromagnetic propagation tool	177	138	SLB
	Gamma ray		260	172	SLB
	ECS	Elemental capture spectroscopy	260	172	SLB
	QCNT	Compensated Neutron log tool	260	207	SLB
	APS	Accelerator porosity sonde	260	172	SLB
	RST	Residual saturation tool	204	138	SLB
	Litho-Density	density	260	207	SLB
	CMR	Combinable magnetic resonance	177	138	SLB
	Sonic	acoustic wave	260	207	SLB
	FMI-HD	Fullbore formation microimager	177	138	SLB
	UBI	Ultrasonic borehole imager	177	138	SLB
	PressureXpress	Pressure	204	138	SLB
	CBL	cement bond	260	207	SLB
	Caliper tool	caliper	232	138	SLB
	Flowmeter		200	103	SLB
	SlimXtreme	gamma-ray	260 (8hr)	207	SLB
		compensated neutron	260 (8hr)	207	SLB
		litho-density	260 (5hr)	207	SLB
		Sonic Logging Tool (QSLT)	260 (8hr)	207	SLB
		AIT (Array Induction Imager tool)	260 (8hr)	207	SLB

3) Tool development projects

Project	National	Contractor/program	Sonde/Product	T.max(°C)	P.max (Mpa)	remarks		References
ZWERG	Germany	Karlsruhe Institute of Technology						
				200	60		done	
			GeoKam_first	165	48	SRO*/Memory type	done	Spatafora et al, 2016
			GeoKam	200	60	Memory type	done	
			sampling probe	200	60		done	Isele et al., 2015
			trace detector	200	60		done	Isele et al., 2015
			casing repair probe	200	60		done	Isele et al., 2015

Project	National	Contractor/program	Sonde/Product	T.max(°C)	P.max (Mpa)	remarks		References
DESCRAMBLE	Italia EU	EU Horizon 2020						
	starting	Jan 5 2015	P/T sonde	450 (8 hr)	45	Memory type	done	Vedum et al., 2017
	duration	36 months						

Project	National	Contractor/program	Sonde/Product	T.max(°C)	P.max (Mpa)	remarks		References
The HiTI	EU	European Sixth Framework Program	P/T/S + casing collar locator	400	60	Memory type	done	Halladay et al., 2010, Asmundsson et al., 2014
			temperature	300	60	SRO*	done	
			natural gamma, GR85	300	140		done	
			dual laterolog electrical resistivity tool	300	60		done	
			Televiewer, ABI92	300	140		done	

DISCUSSION

Increasing needs for high temperature and pressure logging tools are expected due to rapid expansion of geothermal developments and utilizations worldwide. Tools and technologies are to be developed that is applicable in further higher temperature and pressure conditions, such as supercritical geothermal system. Future tool designs will strongly rely on the available material and further material improvements when they become available. Currently some advanced tools tolerating up to 260 degree-C . PT sensor can now be measured up to 300 degree-C in unshield condition and expected to reach the IPGT’s target temperature of 600 degree-C in the near future with the aid of advances in new electronics materials and active heat shielded technology.

Note, again, that NOT all the service companies and their tools worldwide are listed on the table in this study, BUT they are mostly rely on the data provided by the IEA Geothermal participating member countries and the data from the website of major service companies. The listing can be updated whenever additional information arrives from non-member countries or new projects, and hopefully can provide useful information to the ones who are searching for and/or who want to discuss with.

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References

Ásmundsson, R., et al. (2014) High temperature instruments and methods developed for supercritical geothermal reservoir characterisation and exploitation—The HiTI project, *Geothermics*, **49**, pp. 90-98.

Halladay N., et al.(2010) Borehole Instruments for Supercritical Geothermal Reservoirs, *Proceedings of the World Geothermal Congress 2010*, Bali, Indonesia.

Isele, J., et al. (2015) The ZWERG project: a platform for innovative logging tools, *Proceedings, World Geothermal Congress 2015*, Melbourne, Australia.

Spatafora, L., et al. (2016) The GeoKam – A Tool for Video Inspections in Hot Deep Geothermal Boreholes, *Proceedings, Workshop on Geothermal Reservoir Engineering*, Stanford University, Stanford, California, Feb. 22-24.

Vedum, J., et al. (2017) Development of a Novel Logging Tool for 450°C Geothermal Wells, *IMAPS Additional Conferences*, Vol. 2017, pp. 11-19.

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