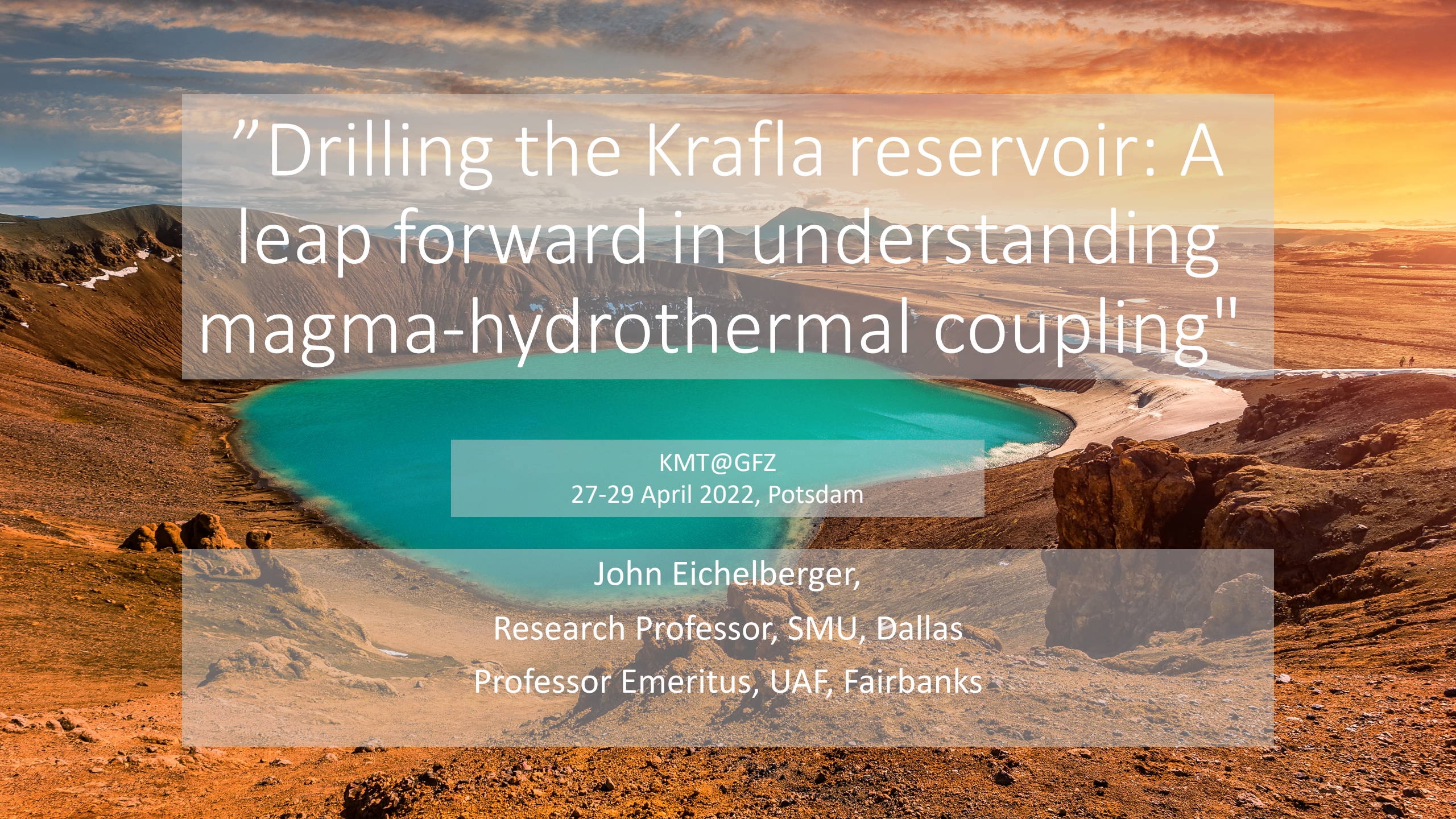


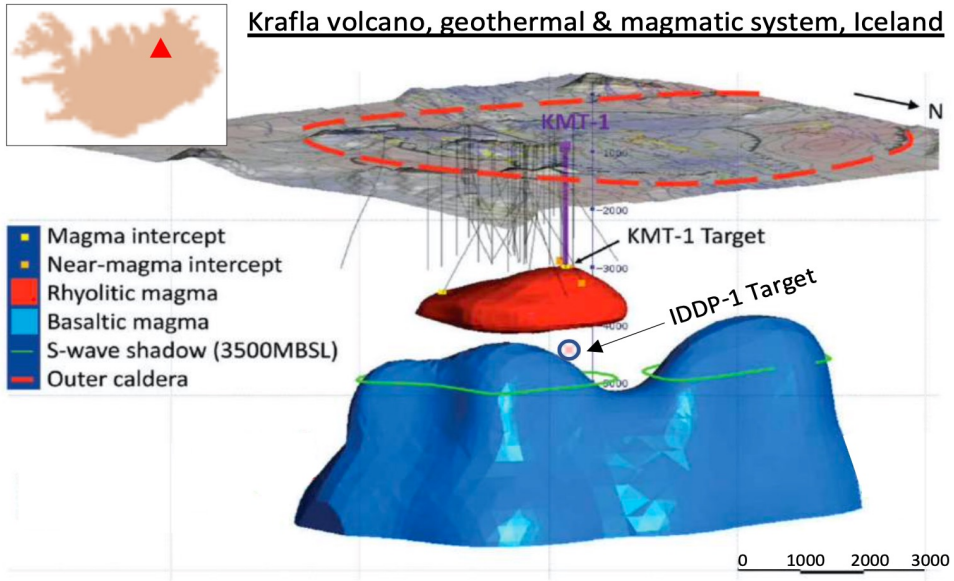
”Drilling the Krafla reservoir: A leap forward in understanding magma-hydrothermal coupling"

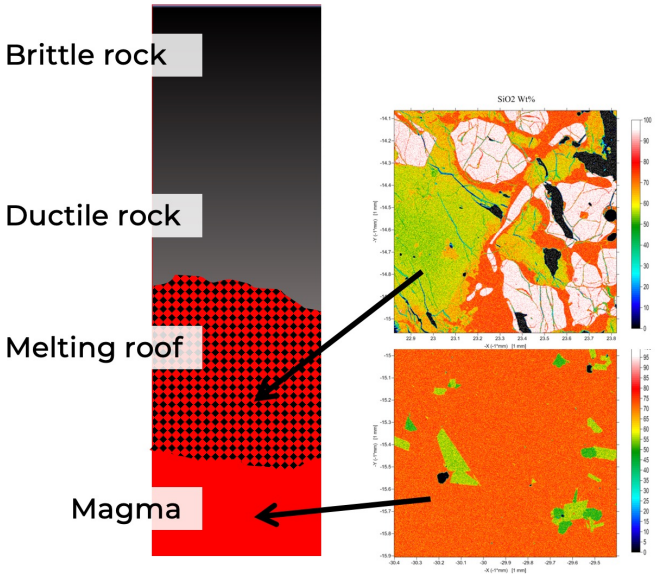
KMT@GFZ
27-29 April 2022, Potsdam

John Eichelberger,
Research Professor, SMU, Dallas
Professor Emeritus, UAF, Fairbanks

The big surprises and questions of IDDP-1

- Why is it there? Magma at only 2 km depth is contrary to conventional wisdom.
- Why was it not seen by geophysics? It was only seen seismically after its position was known.
- How long has it been there? Geodetic monitoring of Krafla is excellent. It could only have been intruded undetected during Krafla Fires. Or has it been there for millennia? But then why has there been no rhyolite eruption in 10^4 a? In either case, why no crystallization at roof?
- How big is it? Under large portion of central caldera (AKM) or a small finger (IDDP).
- What is the relationship between the magma chips and partially melted felsite?





Goals of KMT-1

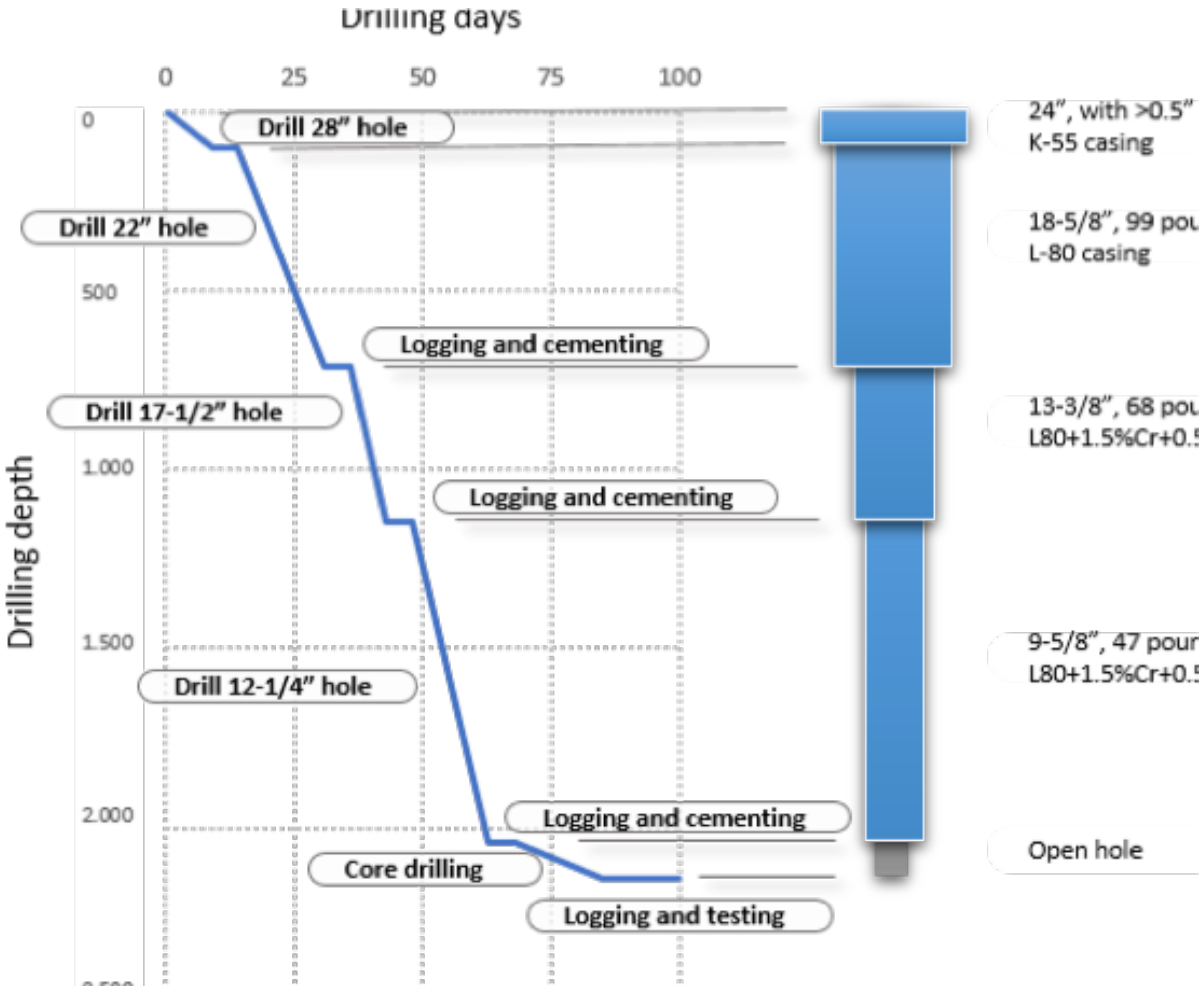
- Build a sustainable well to superhot (high specific enthalpy) conditions
  - This has not been accomplished before (to my knowledge)
  - It is necessary for equilibrium temperature and time series data from KMT-1
  - It is also necessary for use of superhot fluid

- Obtain an equilibrium temperature profile from the hydrothermal system to magma
  - This has not been accomplished before either
  - It provides conductive heat flux from magma to the hydrothermal system and constrains thermal history of magma (instantaneous emplacement vs. long residence)

- Obtain continuous core from hydrothermal system (solid rock) to magma
  - Never before! Cannot be accurately inferred by lab experiments or numerical models
  - Reveals heat and mass fluxes at magma-roof rock contact, dynamics of roof melting and contact information.

- Stress field above magma?

Build a sustainable well to superhot (high specific enthalpy) conditions



Lead:

Sveinbjorn Holmgeirsson GeoEnergy Consulting

New concept:
Use of slip joints in casing.

Obtain an equilibrium temperature profile from the hydrothermal system to magma

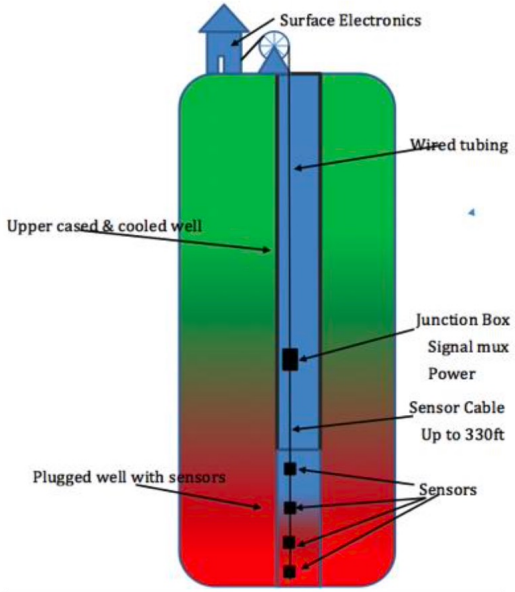


Fig. 11: Concept of long-term monitoring of KMT-1. A string of sensors, in Phase-1 thermocouples, is connected to an electronics package in a higher, cooler, level of the well. Credit: R Normann

Lead:
Randy Normann, Yan Lavallee, Sveinbjorn Holmgeirsson

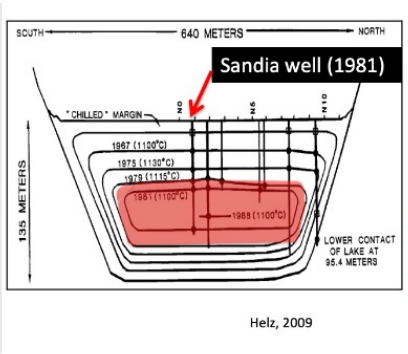
Concept:
Place string of thermocouples through hot, open hole to (or close to) magma. Run cables up well to cooler T for electronics package.

Issue:
Randy is, sadly, deceased. Maybe eHarsh can help?

Obtain continuous core from hydrothermal system (solid rock) to magma

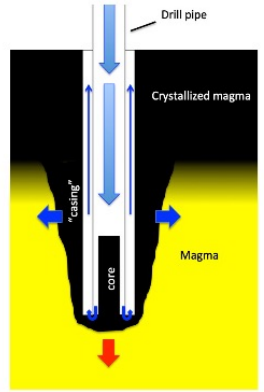
- Coring in lava lakes by quenching melt to glass has been conducted successfully, but never at depth in a major borehole, where the pressure acting to close the hole will be much higher.

Repeated coring during 1960 - 1988 through the 640 m x 136 m lake that accumulated in a pit crater on Kilauea in 1959.



Helz, 2009

Smithsonian NHM



Concept: Use a lot of water and penetration rate based on model calculations. Two fast and bit will outrun quench zone and stick, too slow and quenching will be incomplete, allowing vesiculation.

Lead: Paolo Papale, INGV

Surface and neighboring borehole investigations needed!

- Drilling KMT-1 will represent a major perturbation of the system (cooling, cracking, conversion of magma to glass), from which the system will gradually recover as thermal equibrium is re-established.
- Monitoring of seismic activity (the drill bit represents a seismic energy source), gas emission, gravity, geodesy, MT, etc will be important.
- Baseline measurements should begin before drilling.