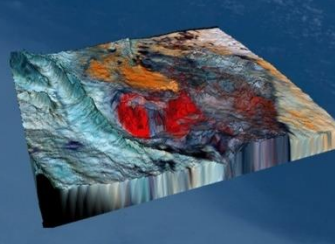
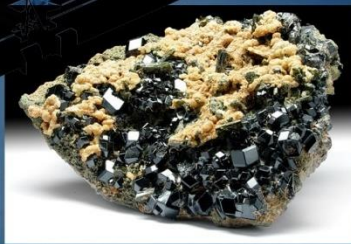




# GEO SAT



**We find Geothermal Resources faster, with less costs and more precisely than anybody else!**

## TECHNICAL PRESENTATION

GEO SAT Study & InnoEX Exploration Method for Geothermal Exploration

23-29th September 2019

Prepared for: *Kazakhstan Energy Week 2019*

Presented by: *Geosat Technology AG / Michael MUMELTER - CEO*

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The Geosat Advance Remotes Sensing Method has 4 principle applications :

OIL AND GAS

ALL MINEALS AND ORES

GROUNDWATER

GEOHERMAL ENERGY ISSUE

- Successfull Exploration of Geothermal Resources :
  - Advanced Remote Sensing
  - Application of Geophysical Methods
  - Application of Geochemical Methods

### Advanced Remote Sensing

- Infrared detection Technology
- Basic principle of this technology is the identification due to the sensitivity at the reaction of mid-infrared (3-5 $\mu\text{m}$ ) and far-infrared (8-14 $\mu\text{m}$ ) spectrum to temperature change.
- Heat energy hosted under the ground would be transported to the surface via different types of conduction and convection
- Effect higher surface temperature than normal surface temperature
- Heat island (thermal anomalies) detected by remote sensing
- Thermal infrared (TIR) remote sensing data employed to delineate temperature anomalies with surface geothermal anomalies such as hot springs, geysers and heated ground.
- Cost effective tool for larger areas
- High resolution airborne thermal infrared studies

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## Airborne Remote Sensing

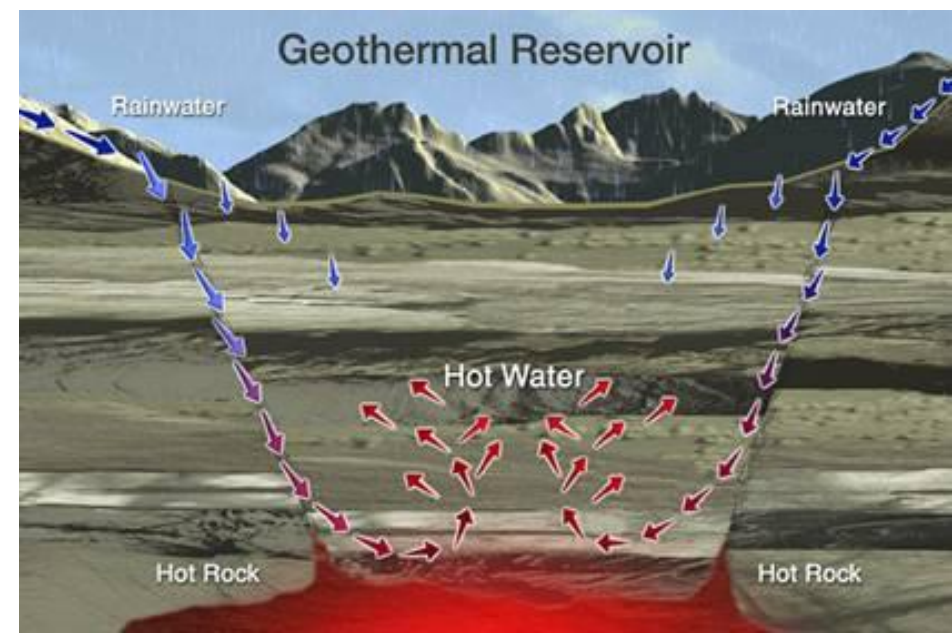
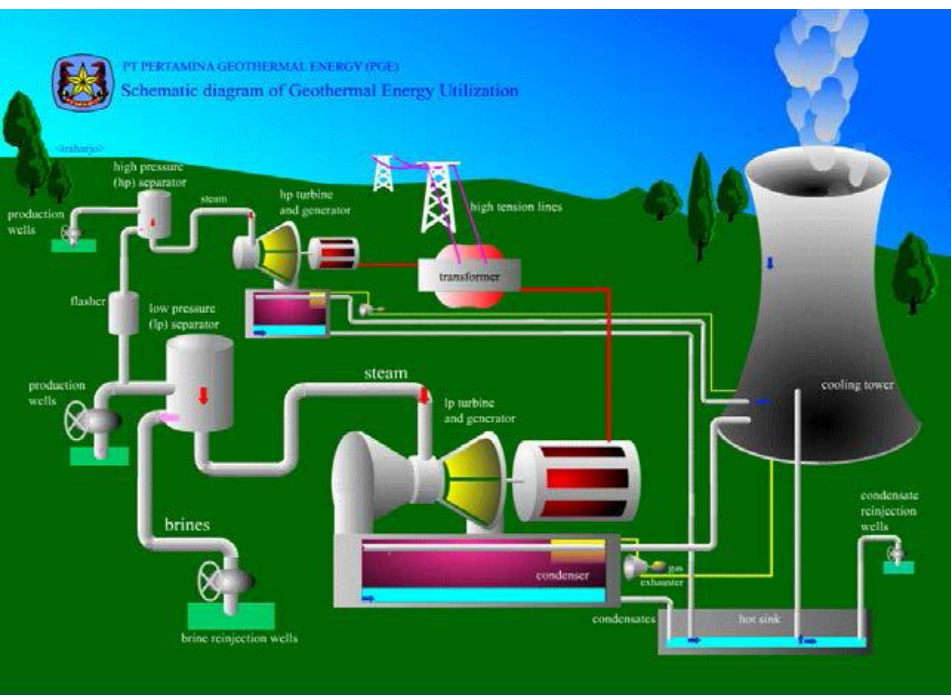


### GEO PHYSICAL METHOD

- Subsurface temperature and thermal gradient survey
- Gravity surveys – important indication of the fluid recharge in geothermal systems and the need of re-injections
- Magnetic surveys – usefull mapping near surface volcanic rocks – geatest potential for the method – ability to dedect the depth at which CURIER temperature is reached (570 grad C)
- Siesmic methods
  - Passive siesmic
  - siesmic reflection and seismic refraction method
- Geophysical well logging and borehole method
- Electrical methods
- Natural Source method – Magnetotelluric Method
- Self-potential method (spontaneous polarization SP)
- Artificial source electromagnetic (EM)

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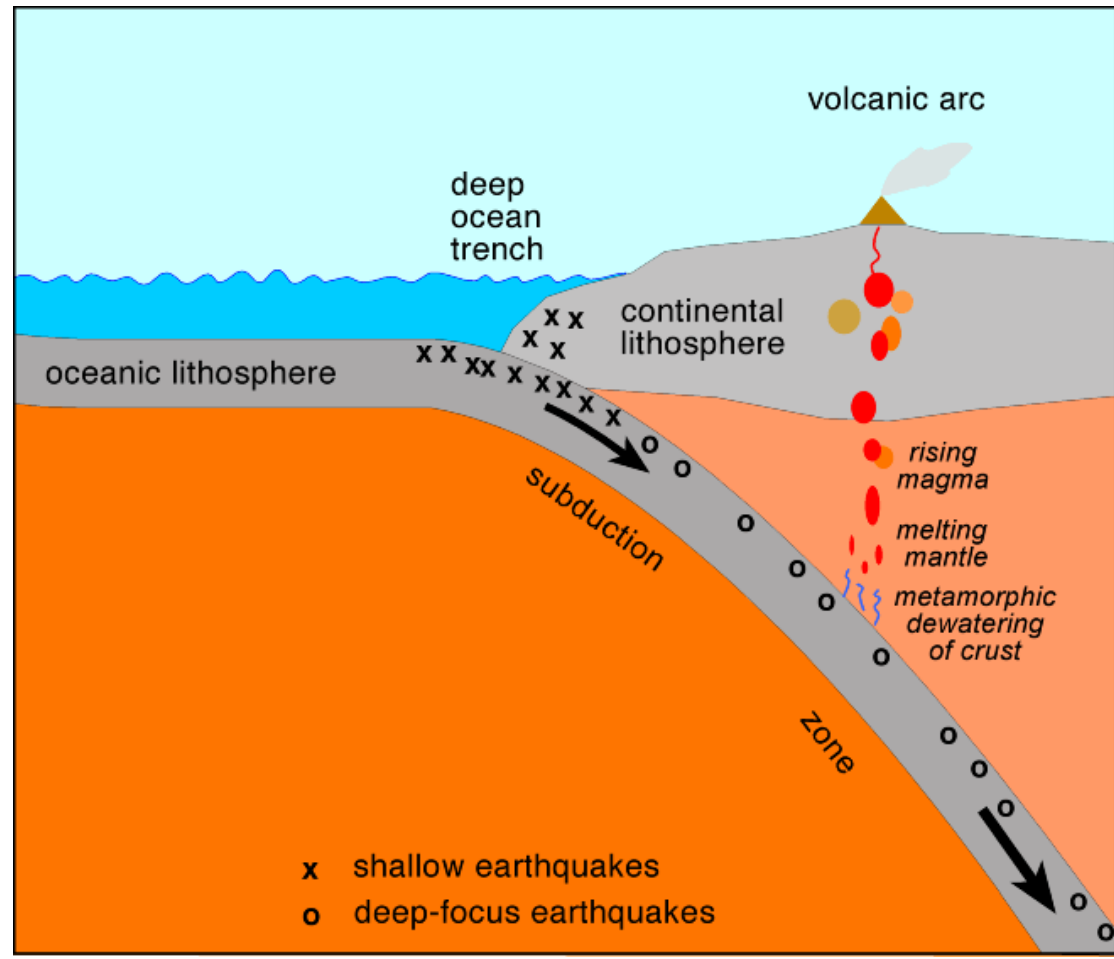
## Geothermal Energy principles

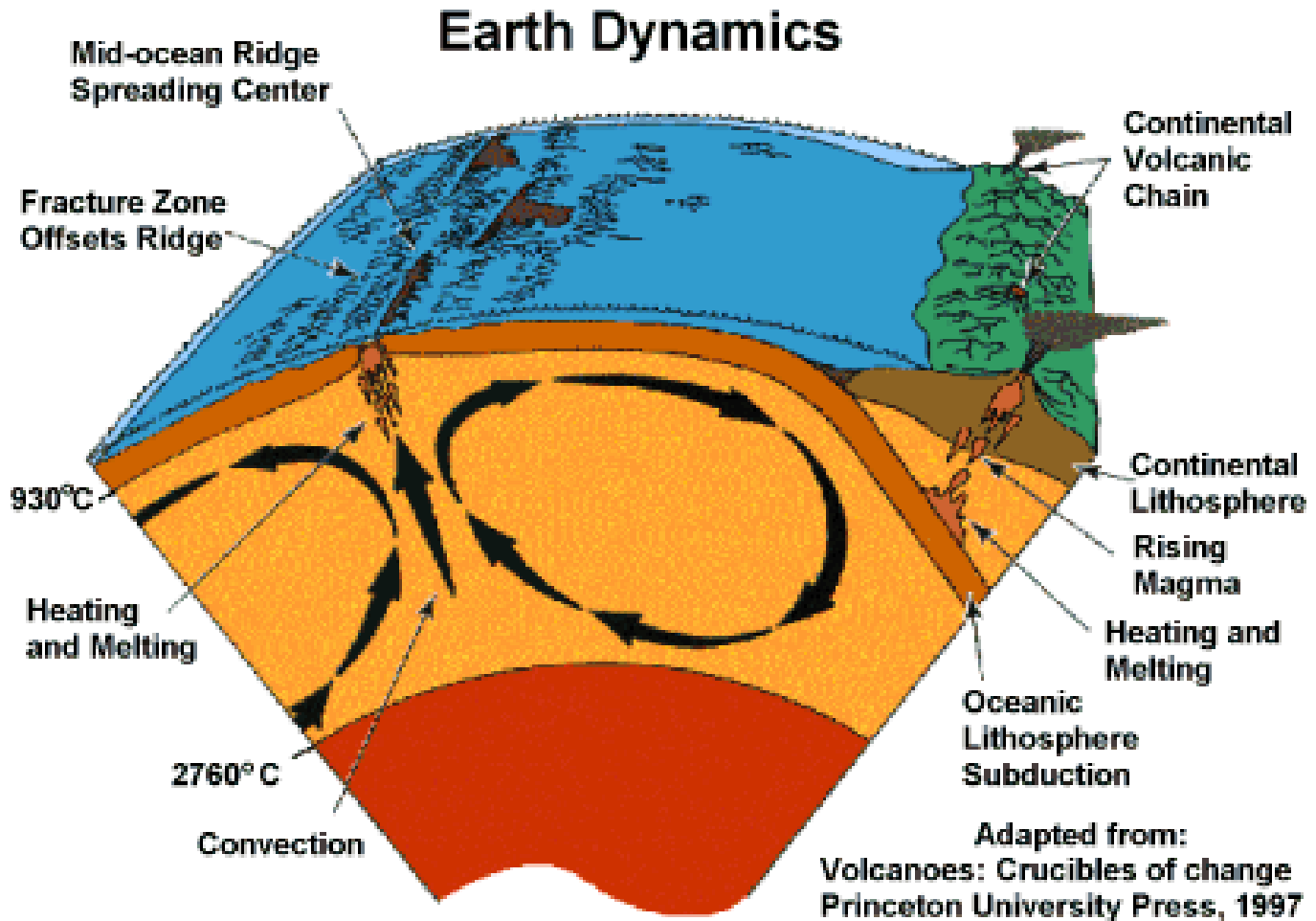


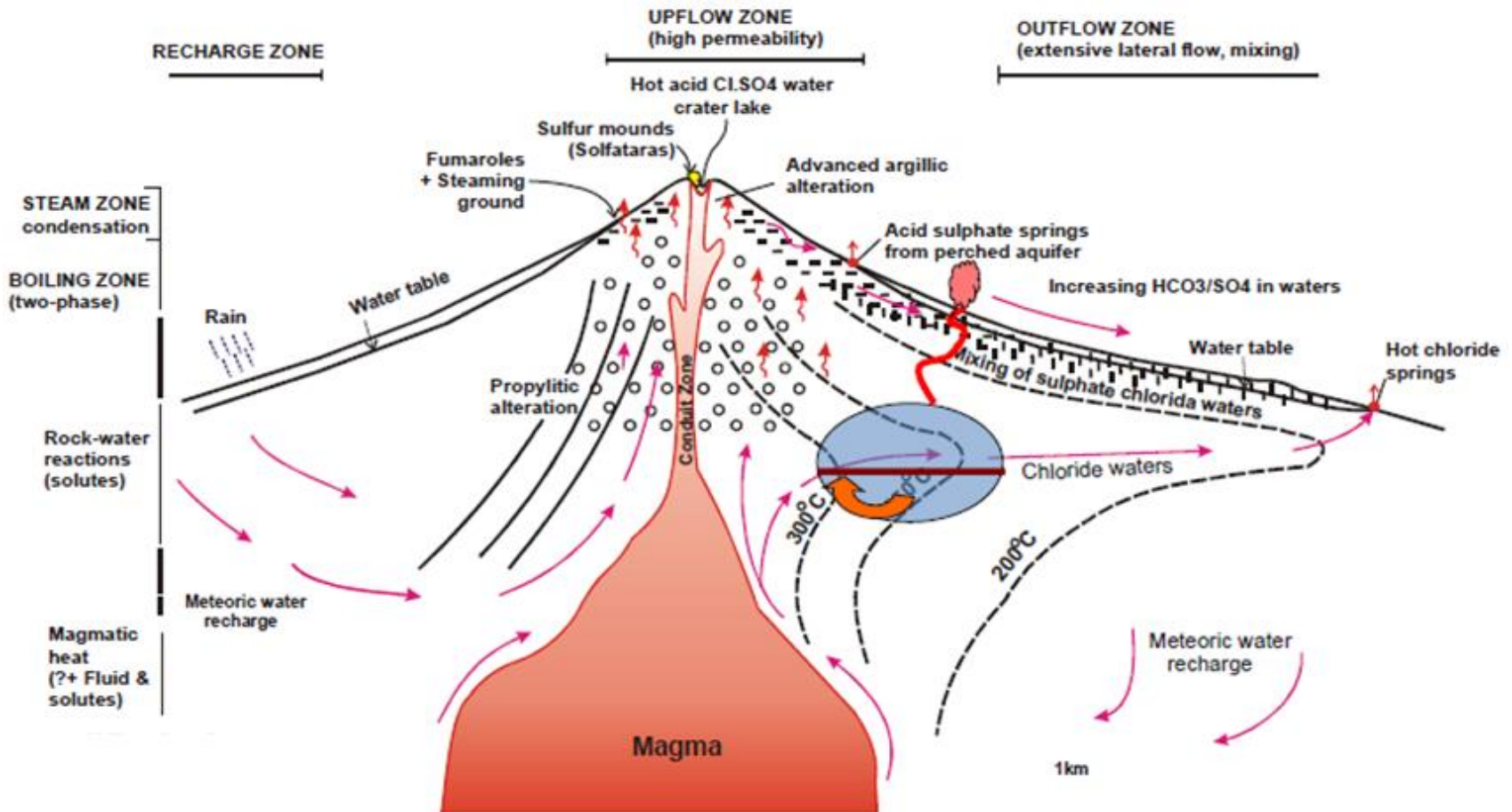
## Advantage of using the Geosat method:

- 🌐 Excellent exploration tool in order minimize cost and time for any further geological, geochemical and/or geophysical survey
- 🌐 No new data acquisition required
- 🌐 Doubling the drilling success
- 🌐 Environmental friendly and non-invasive

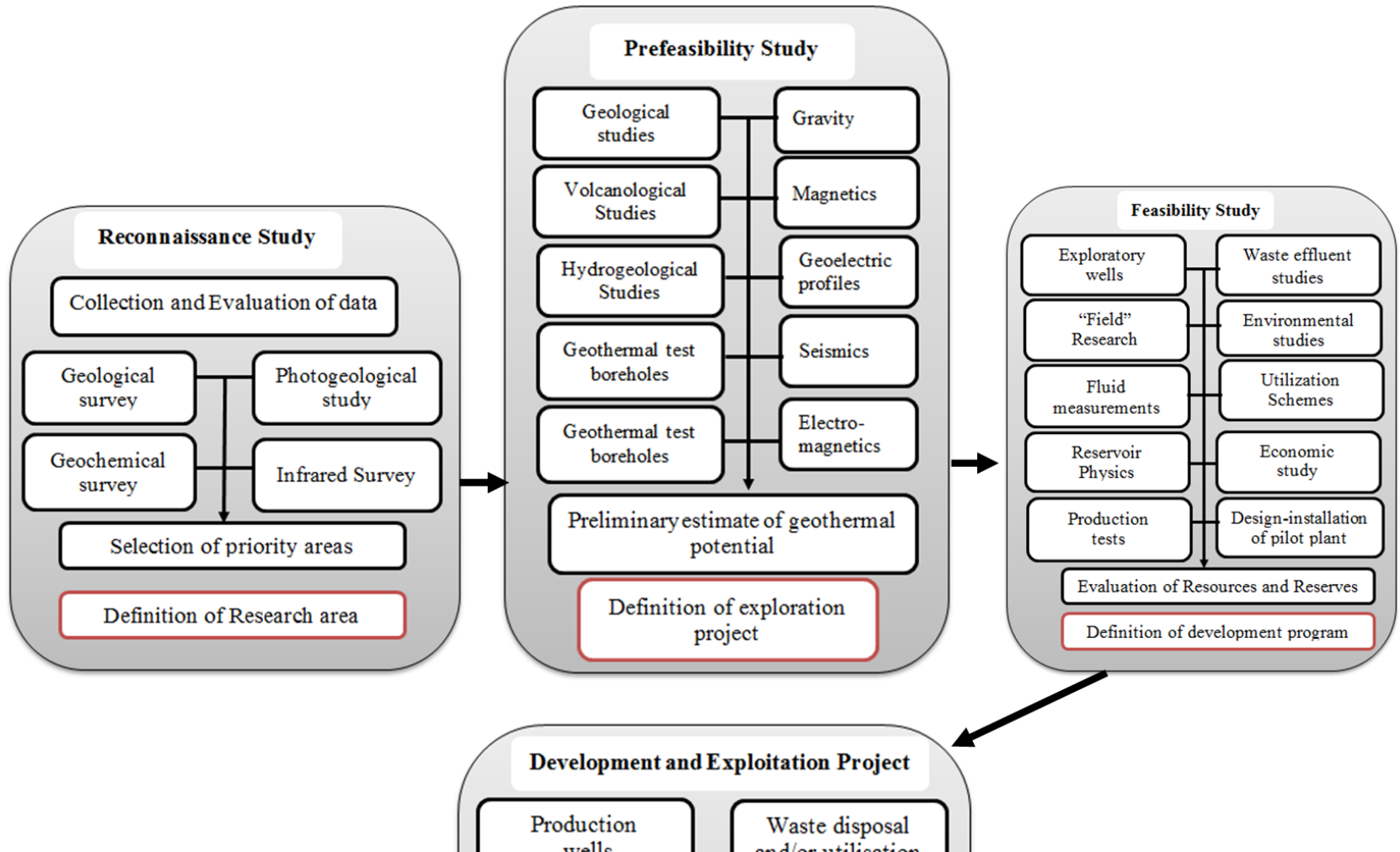








## GEOTHERMAL DEVELOPMENT SCHEME



### InnoEx Method- creating the evidence of GEOTHERMAL EXPLORATION

- 🌐 **Step 1: Geosat Method (advanced remote sensing)**
  - 🌐 Step 2: Geochemical method (MBGE)
  - 🌐 Step 3 : Geo-electrochemical method (HRGC)
  - 🌐 Step 4: Magneto Telluric (MT) or CSEM or HREM
  - 🌐 Step 5: High Resolution Ground Magnetics (HRGM)
  - 🌐 Step 6: High Resolution Ground Gravity (HRGG)
- } 2 geochemical methods
- } 3 non-seismic geophysical methods

**And integrating of all 8 levels of information for defining optimum well drilling location**

#### **Recommendation**

- 🌐 If and when necessary - focused (pin-pointed = area defined by the Geosat Method) 2D and/or 3D seismic acquisition
- 🌐 More extensive remote sensing study at scales 1:50.000 -1:25.000 with "identified benchmark structures"
- 🌐 Oil Geochemistry

## InnoEx Method

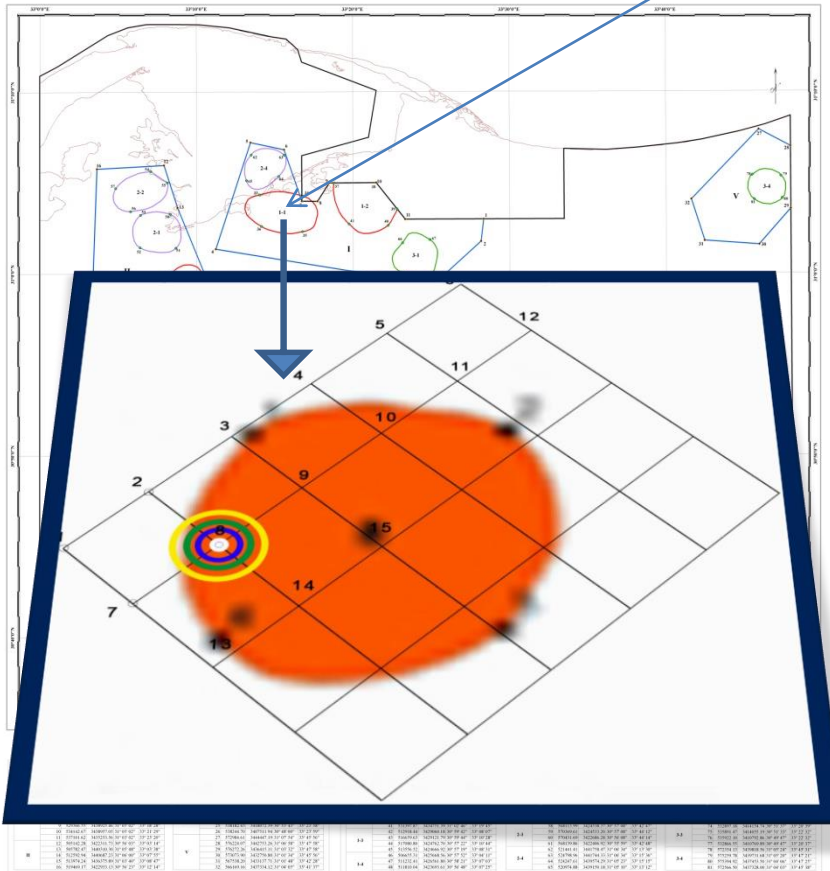
Area determined by Geosat Method (remote seining)







**North El Maghara Area**  
Map of Recommended Sites for Field Exercises  
1:100 000

Appendix 2

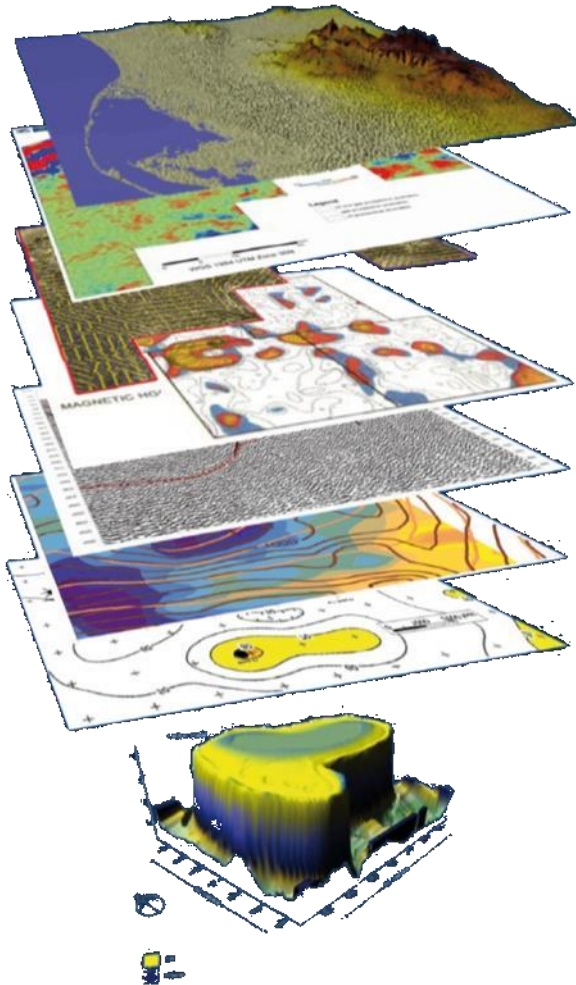
2008



-  1,2,3... Grid points
-  Point 8 shows an InnoEx Grid point
-  White Magneto Telluric
-  Blue Microbiological & Geochem Survey

### OPTIONAL :

-  Green HRGM + HRGGR
-  Yellow Geo-electrochemical



## Superimposing of cutting edge technologies

### **STEP 1 : GEOSAT Method(advanced remote sensing)**

STEP 2 : Microbiological & Geochem

STEP 3 : Geo-Electrochemical

STEP 4 : Magneto Telluric and/or CSEM or HREM

STEP 5 : High Resolution Ground Magnetic

STEP 6 : High Resolution Ground Gravity

2 geochem  
methods

3 non seismic  
Geophysical  
methods



**Integration of all data to define optimum  
drilling location**

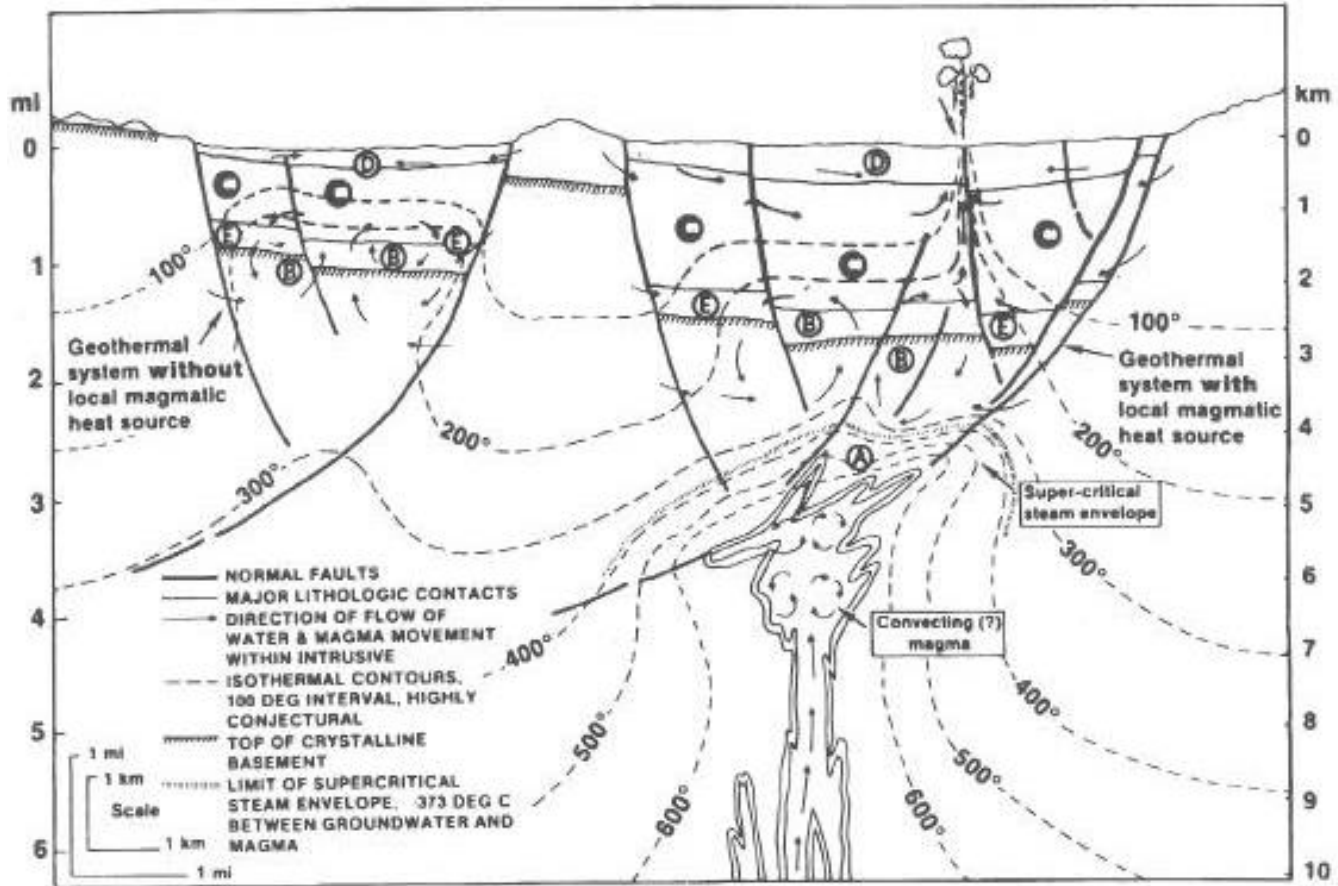
## Field-portable passive telluric data estimate depths to formation tops and fluid content



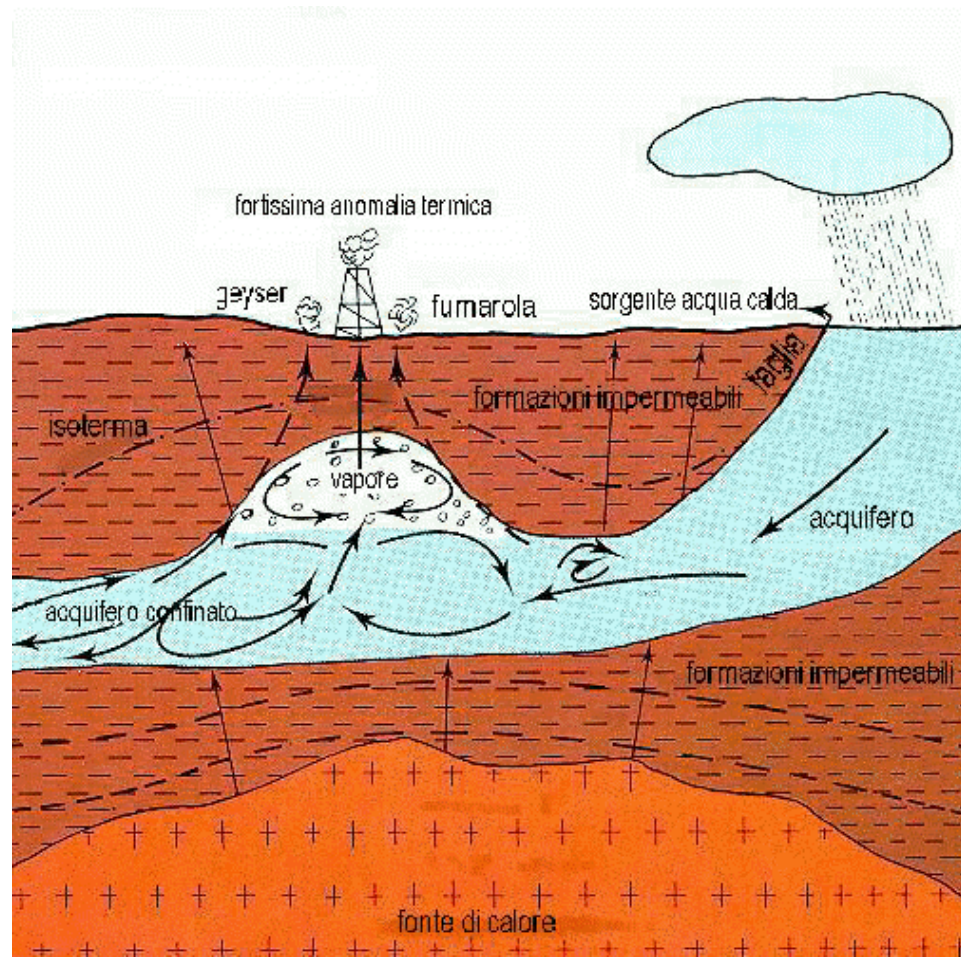


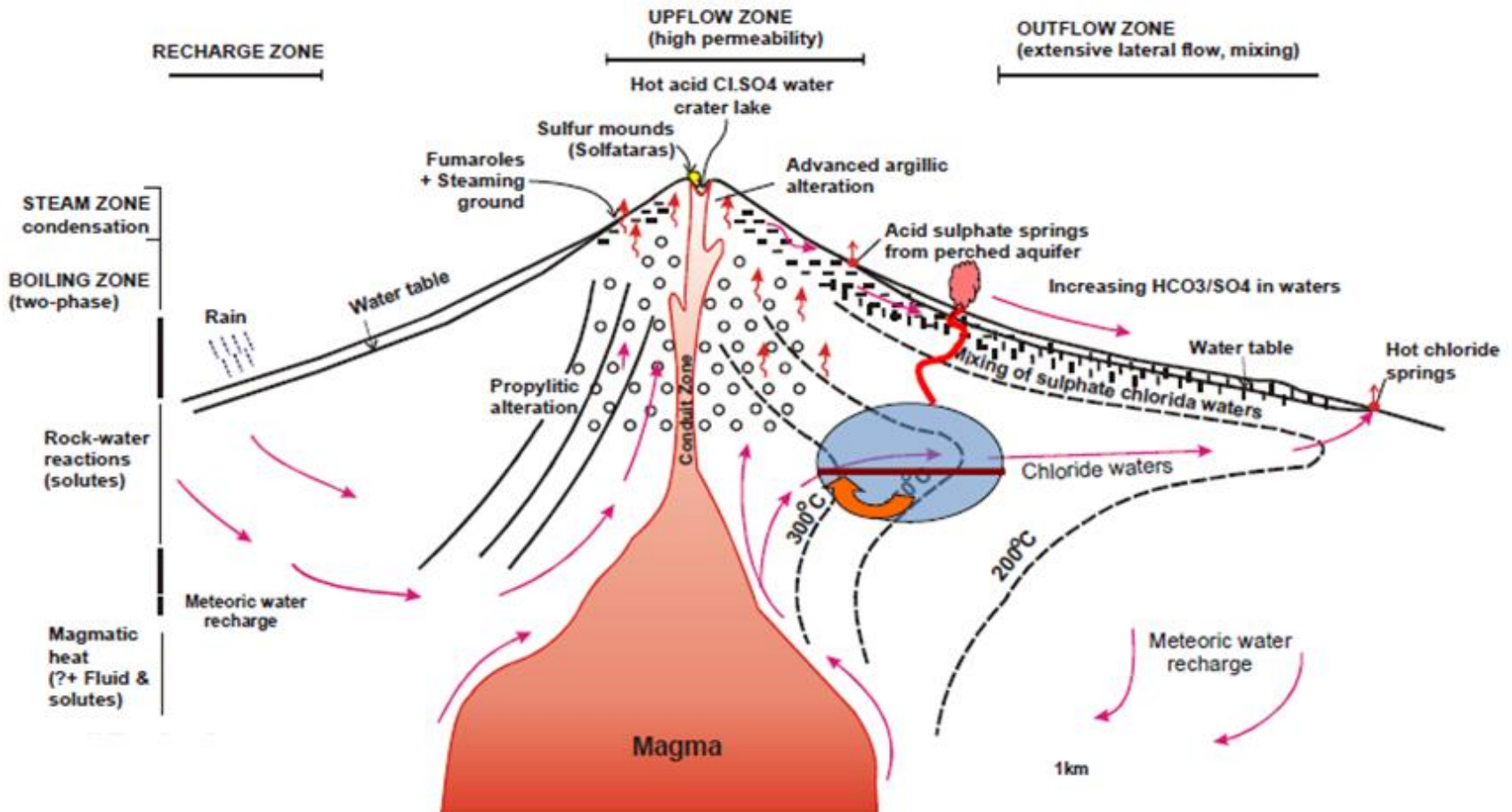
## Passive telluric tools can be carried on your back or mounted on an ATV





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- The basic philosophy behind using geochemical method in geothermal explorations is that fluids on the surface (aqueous solutions or gas mixture) reflect physico-chemical and thermal conditions in the geothermal reservoir at depth.

## GOALS OF THE GEOCHEMICAL EXPLORATIONS

- The major goals of geochemical exploration are to obtain the subsurface composition of the fluids in a geothermal system and to use this to obtain information on temperature, origin, and flow direction, which help in locating the subsurface reservoir.
- Subsurface waters have been classified into meteoric water, ocean water, evolved connate water, magmatic water, and juvenile water. Geothermal water is mostly meteoric and oceanic water, although andesitic waters near subduction areas often contain significant proportions of evolved connate and magmatic waters.
- Geothermal waters have been classified with respect to their anion and cation contents into alkali-chloride water, acid sulphate water, acid sulphate-chloride water, and bicarbonate water.
- Acid waters are generally unsuitable for elucidation of subsurface properties. Conservative constituents are used for tracing the origin and flow of geothermal fluids, stable isotopes (especially H-2 and O-18), along with B and Cl being most important.
- Rock forming constituents (e.g. SiO<sub>2</sub>, Na, K, Ca, Mg, CO<sub>2</sub>, and H-2) are used to predict subsurface temperatures and potential production problems such as deposition and corrosion.

**Gulf News**  
**from 4<sup>th</sup> of November 2008:**

*The UAE's energy minister stated:*

“It is common knowledge that the age of easy oil is gone forever. Consequently, we need to seize the opportunities offered by new technology to advanced exploration techniques for new discoveries...”

## Minister underscores importance of continuous energy investment

MOHAMMAD INAUGURATES FOUR-DAY PETROLEUM EXHIBITION IN CAPITAL

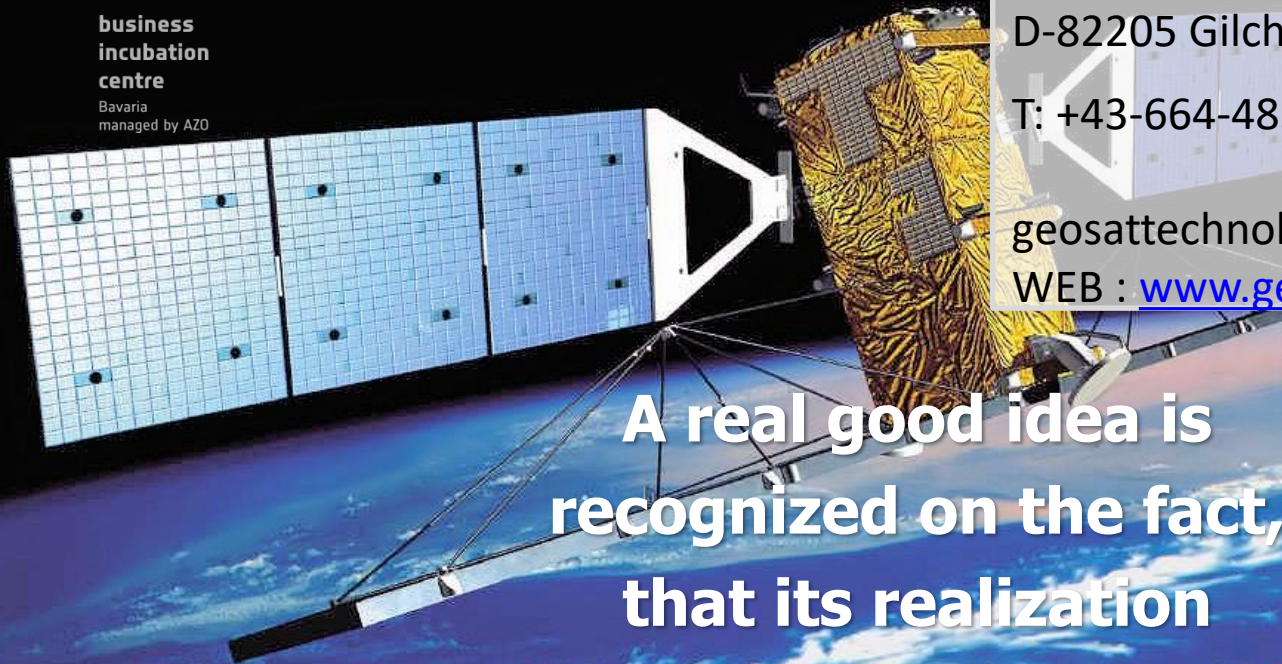


RAVINDRANATH/Gulf News









**A real good idea is  
recognized on the fact,  
that its realization  
seems to be impossible from the beginning!**

**(Albert Einstein)**

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