Geochemical Exploration of Precious & Industrial Minerals in Desert Lands in ECO Member States

Economic Cooperation Organization

Ministry of Industry, Mine and Trade
Geological Survey of Iran
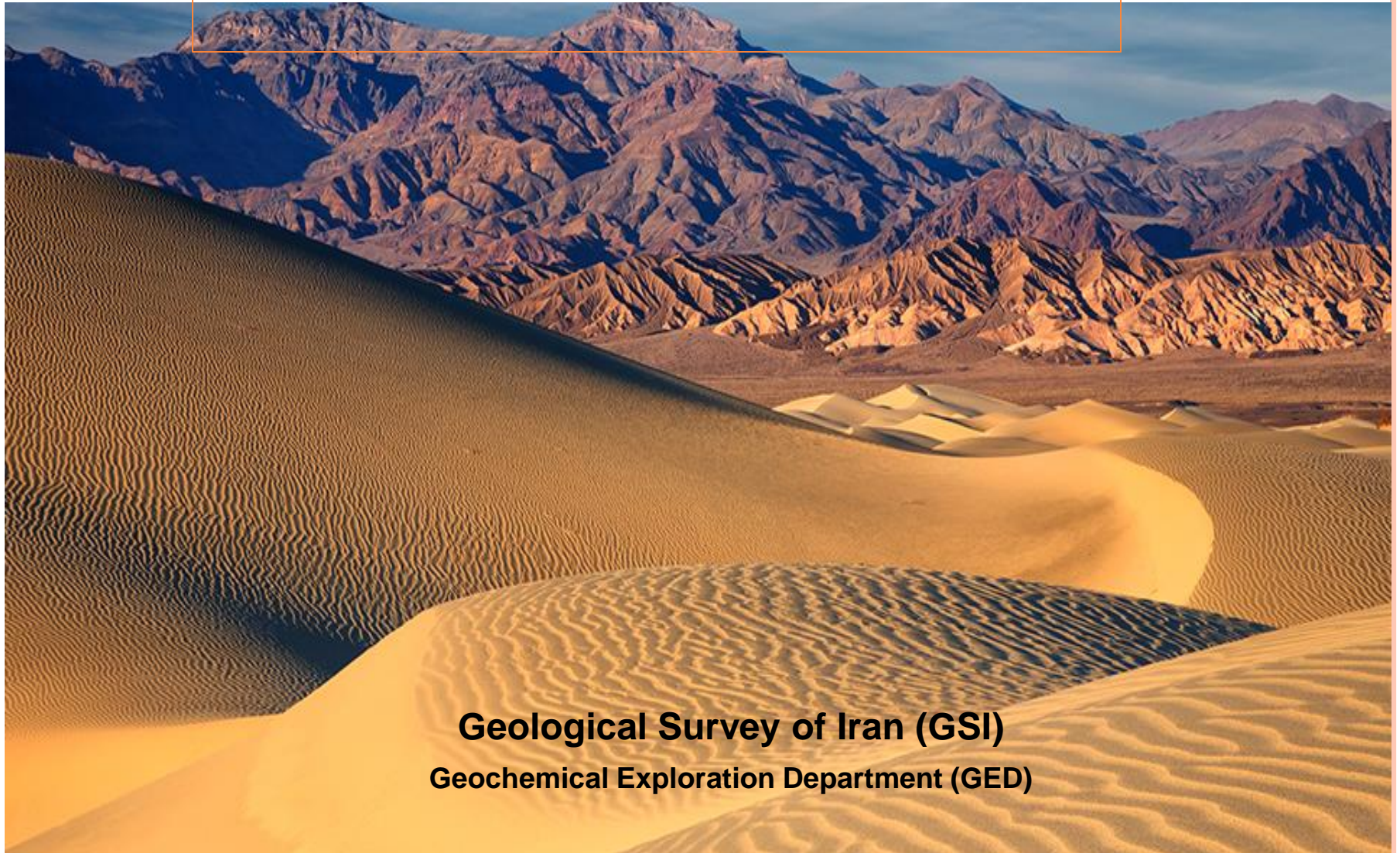
Geological Survey of Iran (GSI)

Geochemical Exploration Department (GED)

PRECIOUS & INDUSTRIAL MINERALS

- ✓ Precious elements (gold, silver)
- ✓ Abrasive minerals (corundum, garnet, apatite)
- ✓ Fluxes & refractory minerals (zircon, chromite, forsterite)
- ✓ Salts (halite, sylvite, lithium)
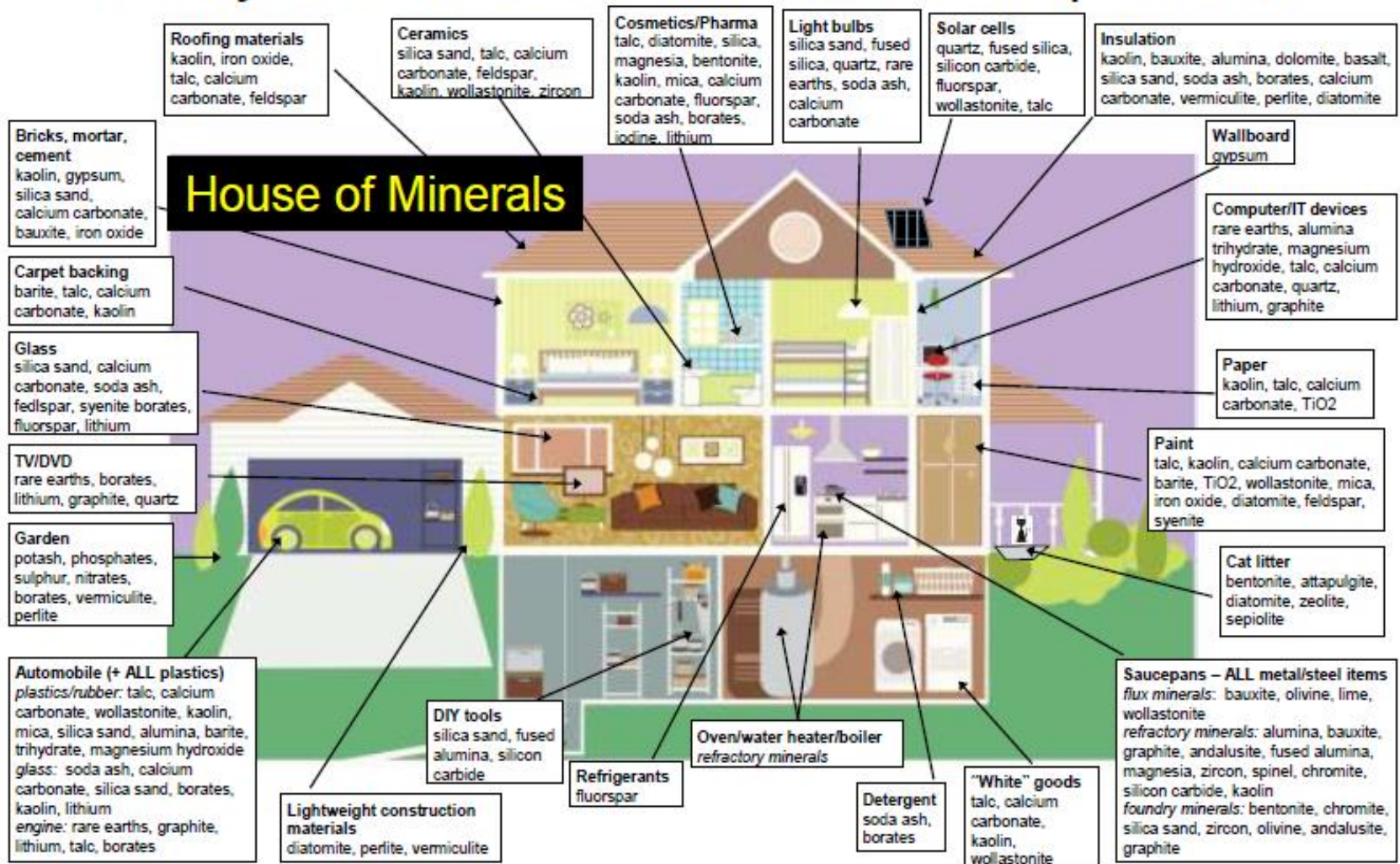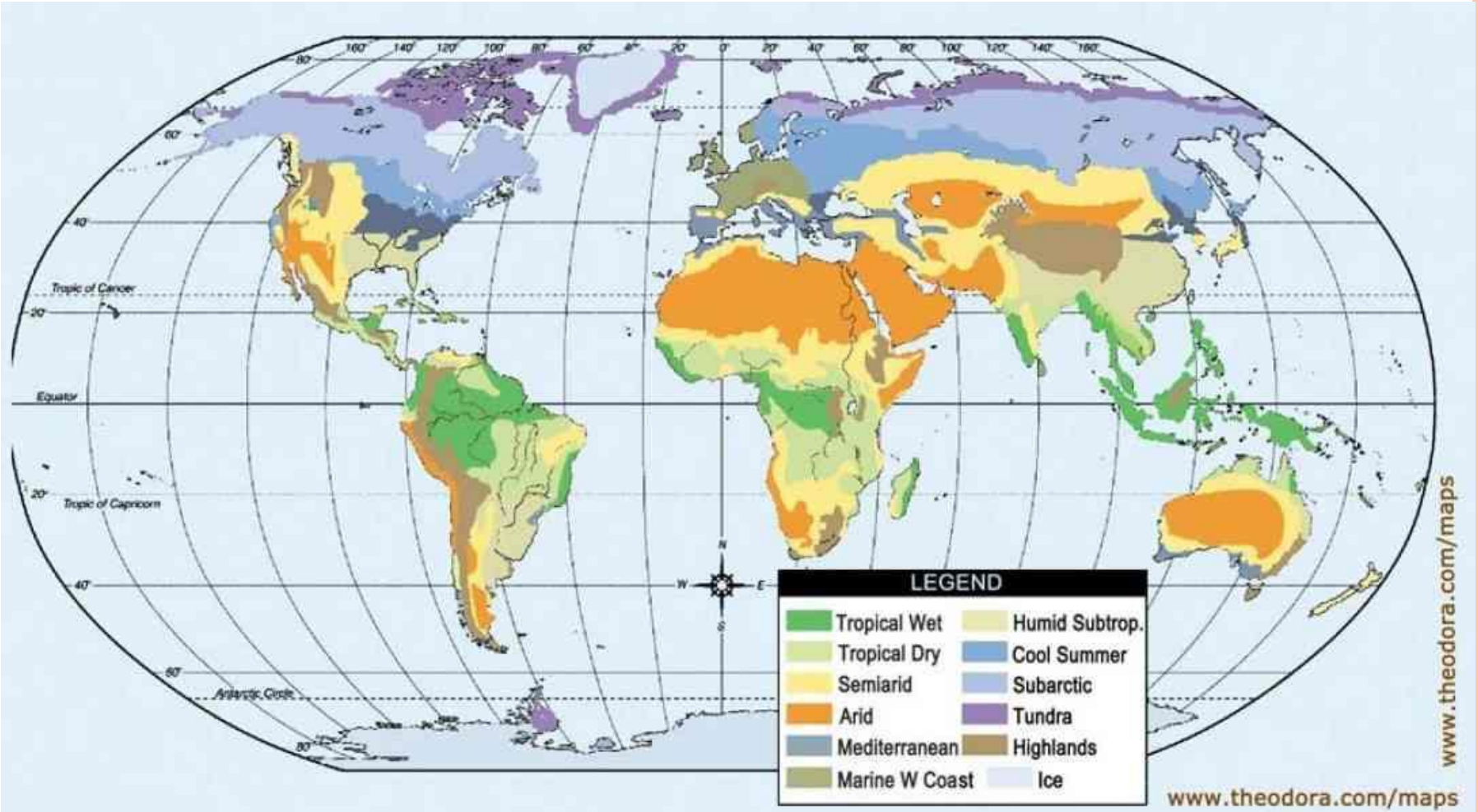- ✓ Monazite & xenotime (REE group elements)

talc

paper

cosmetics

ceramics

1. Why are industrial minerals so important?

House of Minerals

Roofing materials
kaolin, iron oxide, talc, calcium carbonate, feldspar

Ceramics
silica sand, talc, calcium carbonate, feldspar, kaolin, wollastonite, zircon

Cosmetics/Pharma
talc, diatomite, silica, magnesia, bentonite, kaolin, mica, calcium carbonate, fluorspar, soda ash, borates, iodine, lithium

Light bulbs
silica sand, fused silica, quartz, rare earths, soda ash, calcium carbonate

Solar cells
quartz, fused silica, silicon carbide, fluorspar, wollastonite, talc

Insulation
kaolin, bauxite, alumina, dolomite, basalt, silica sand, soda ash, borates, calcium carbonate, vermiculite, perlite, diatomite

Bricks, mortar, cement
kaolin, gypsum, silica sand, calcium carbonate, bauxite, iron oxide

Wallboard
gypsum

Computer/IT devices
rare earths, alumina trihydrate, magnesium hydroxide, talc, calcium carbonate, quartz, lithium, graphite

Carpet backing
barite, talc, calcium carbonate, kaolin

Glass
silica sand, calcium carbonate, soda ash, fedlspar, syenite borates, fluorspar, lithium

Paper
kaolin, talc, calcium carbonate, TiO2

TV/DVD
rare earths, borates, lithium, graphite, quartz

Paint
talc, kaolin, calcium carbonate, barite, TiO2, wollastonite, mica, iron oxide, diatomite, feldspar, syenite

Garden
potash, phosphates, sulphur, nitrates, borates, vermiculite, perlite

Cat litter
bentonite, attapulgite, diatomite, zeolite, sepiolite

Automobile (+ ALL plastics)
plastics/rubber: talc, calcium carbonate, wollastonite, kaolin, mica, silica sand, alumina, barite, trihydrate, magnesium hydroxide
glass: soda ash, calcium carbonate, silica sand, borates, kaolin, lithium
engine: rare earths, graphite, lithium, talc, borates

DIY tools
silica sand, fused alumina, silicon carbide

Oven/water heater/boiler
refractory minerals

Refrigerants
fluorspar

Detergent
soda ash, borates

"White" goods
talc, calcium carbonate, kaolin, wollastonite

Saucepans – ALL metal/steel items
flux minerals: bauxite, olivine, lime, wollastonite
refractory minerals: alumina, bauxite, graphite, andalusite, fused alumina, magnesia, zircon, spinel, chromite, silicon carbide, kaolin
foundry minerals: bentonite, chromite, silica sand, zircon, olivine, andalusite, graphite

Lightweight construction materials
diatomite, perlite, vermiculite

DESERTS COVER ABOUT ONE-THIRD OF THE EARTH'S LAND SURFACE AREA
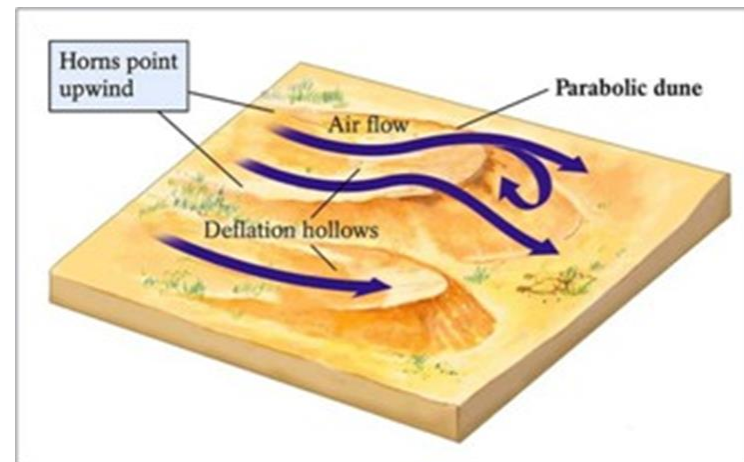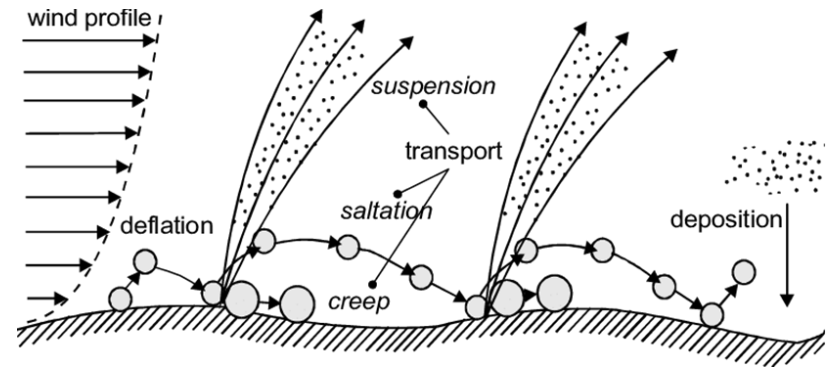
WHY DESERT LANDS?

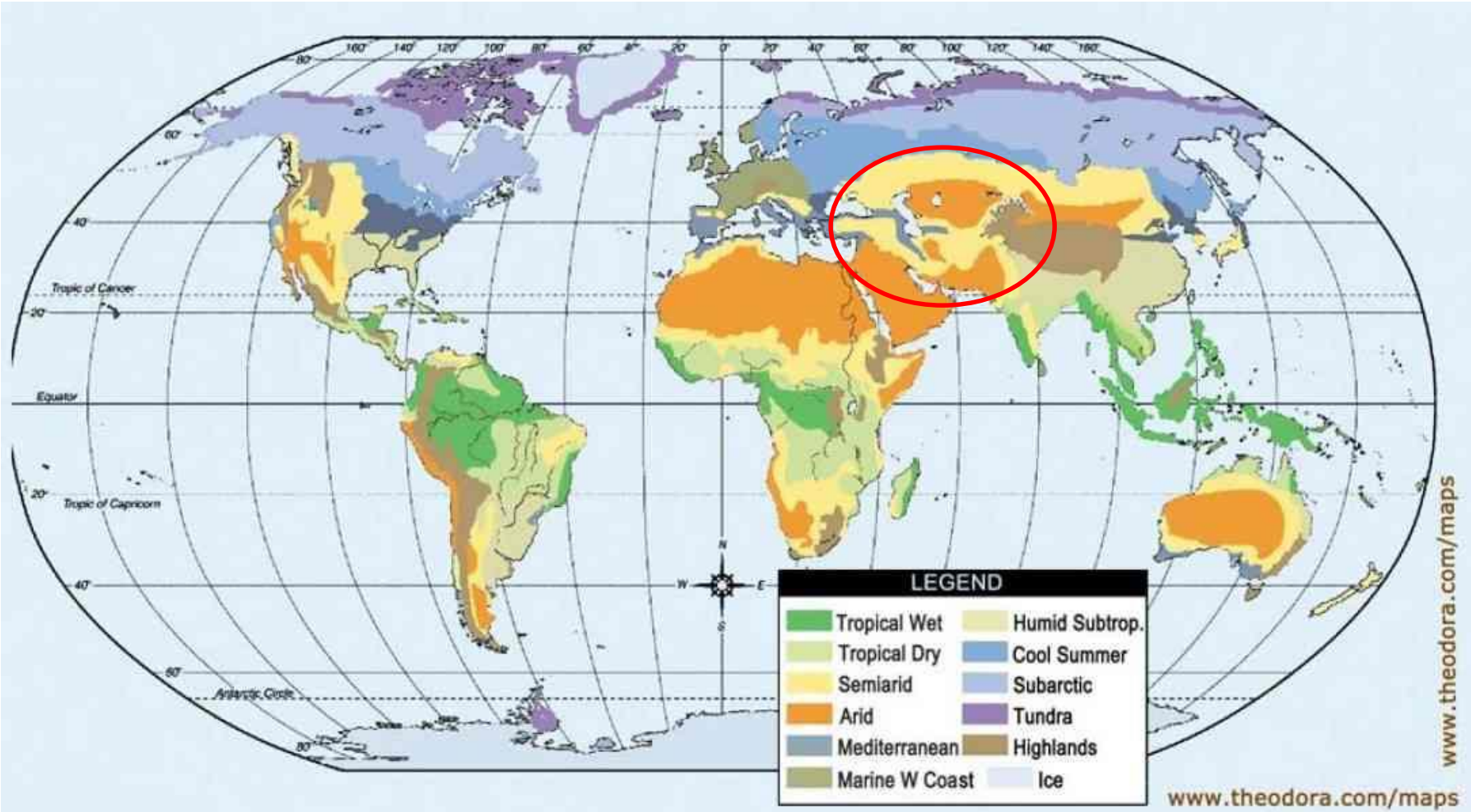Desert lands are unknown and mysterious areas for geologists for these reasons:

- Lack of rock outcrops to study

- Traditional exploration methods don't meet the needs

- Field work limitation because of hard climatological condition and even lack of security

- Deserts contain valuable mineral deposits formed in the arid environment or that were exposed by erosion

- Great volumes of aeolian deposits and large reserves of valuable minerals (placers, residual and abrasive minerals)

- Ease and low cost of exploitation

- Low cost of ore dressing because of primary mineral processing by nature

- Probability of seeking hidden reservoirs in depth

LEGEND

Tropical Wet	Humid Subtrop.
Tropical Dry	Cool Summer
Semiarid	Subarctic
Arid	Tundra
Mediterranean	Highlands
Marine W Coast	Ice

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ECO Member States possess:

- Vast desert lands
- Wealth of mineral resources that remain largely undeveloped, including precious and industrial minerals

PROJECT STAGES

- Desk Study and Site Selection
- Designing Sampling Network
- Sampling
- Sample Preparation & Analysis
- Data Processing
- Map Preparation
- Identification of promising areas

- **Collecting existed reports, data and maps**
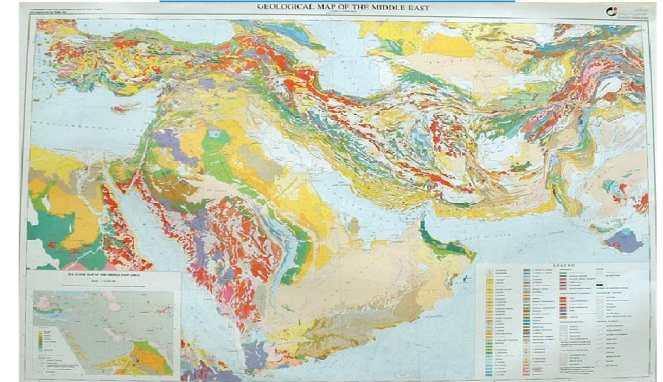
  - **All collected data and paper-based maps must be GIS ready (with UTM coordinate) by transferring into a digital format with the maximum possible resolution.**
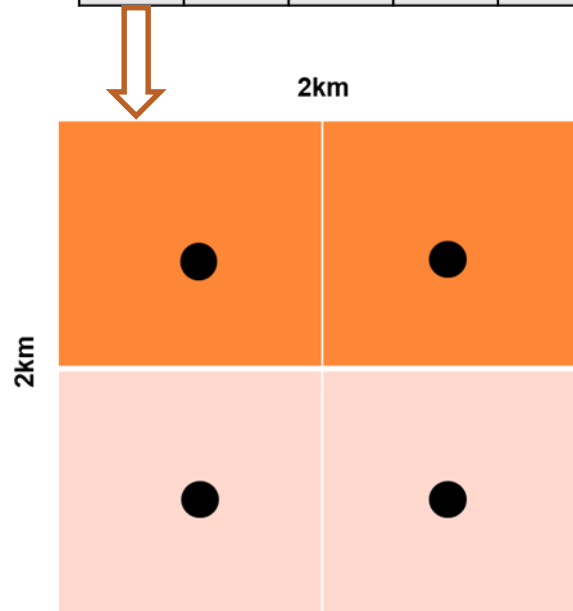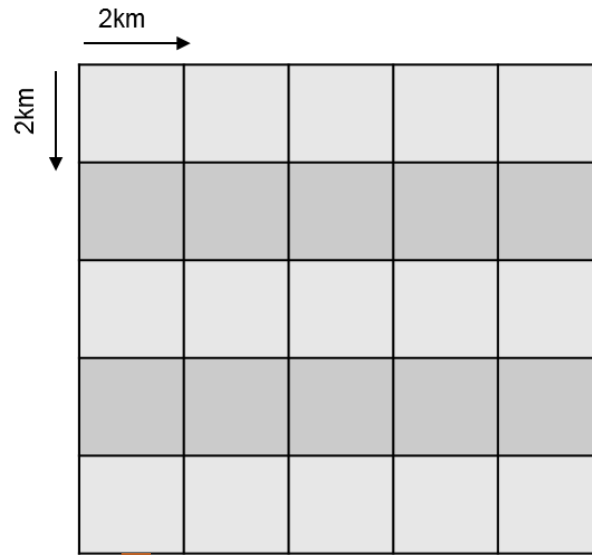
Land cover

TURKMENISTAN   UZBEKISTAN   DUSHANBE   TAJIKISTAN   CHINA

AFGHANISTAN

KABUL

ISLAMABAD

IRAN

Study Area
(100 km²)

PAKISTAN

INDIA

Rangeland
Rainfed croplands
Irrigated cropland
and gardens
Forest
Fruit trees
Sand dunes
Vineyards
Marshland
Forest depletion

indications
. . . .
Structues

Site Selection

DESIGNING SAMPLING NETWORK

10 km

10 km
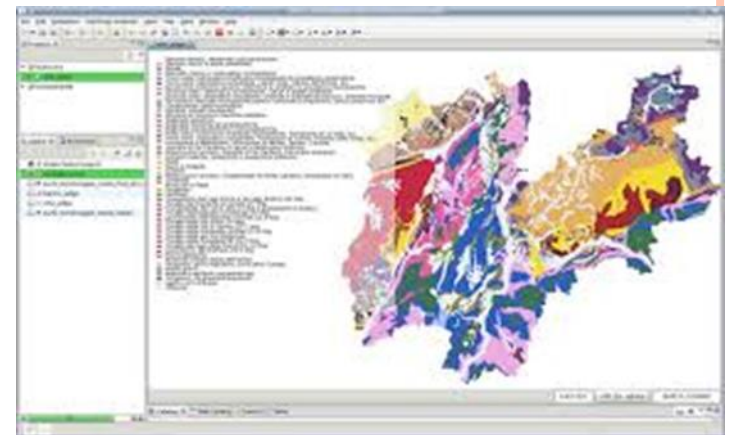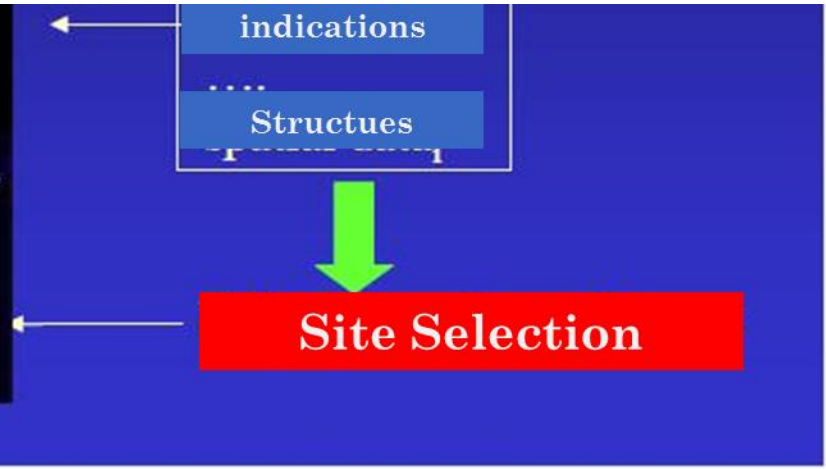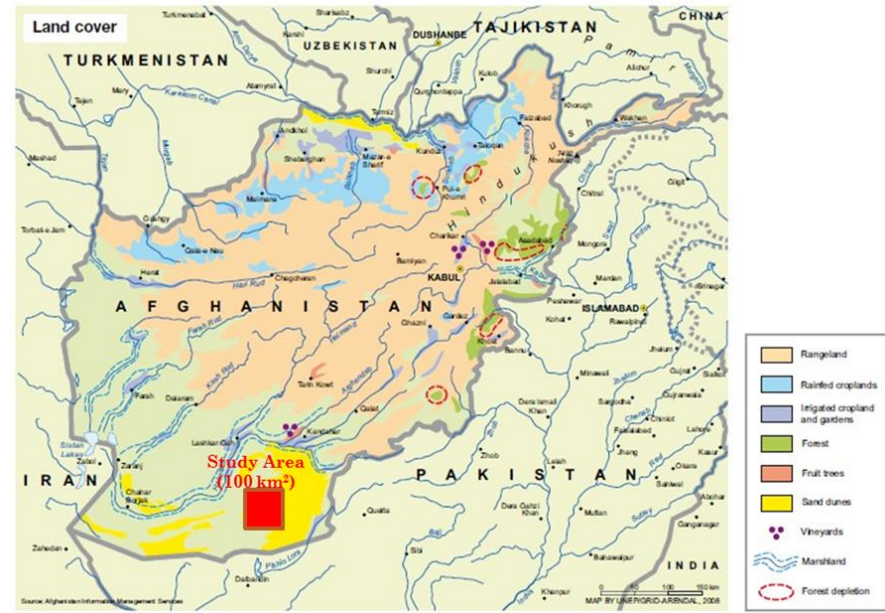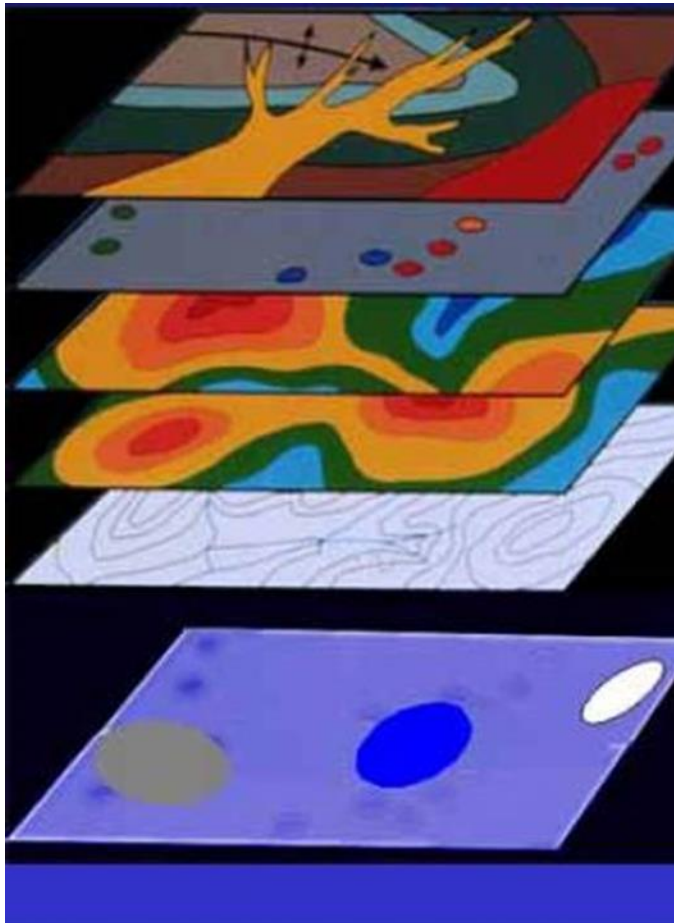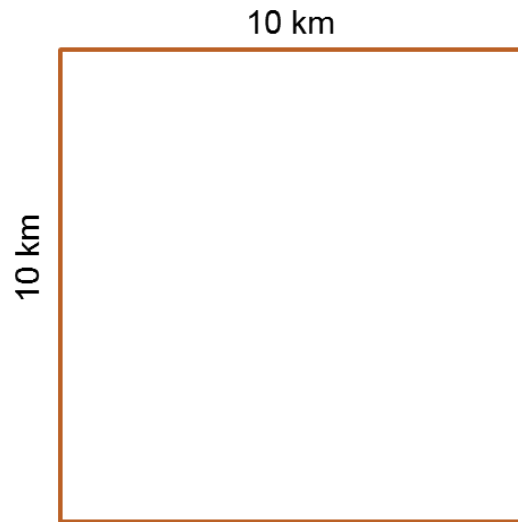
Study Area =100 Km^2 = 100 Samples

2km

2km

2km

2km

SAMPLING

Every sampling site= 1 Sample
Sample weight= 25 kg

Sample

Panning

Seperation by Heavy Liquids

Magnetic Seperation

AA Minerals

AV Minerals

NM Minerals

Microscopic Study

Microscopic Study

Microscopic Study

Mineralogy

Composite Sample

Preparation

ICP-MS

Chemical Analysis (54 Elements)

DATA PROCESSING

| Reference Water	pH	Ca	Mg	HCO₃	SO₄	Na	Cl	Alkalinity (CaCO₃)	Hardness (CaCO₃)	Hardness to Alkalinity Ratio	Ca / 100	Style
Raleigh, NC	8.16	6.74	2.91	44.2	30.6	26.2	13.7	36.3	30.8	0.85	0.1	
Pilsen		10	3	3	4	3	4	2.5	37.33	15.17	0.1	Pilsner
Dortmund		225	40	220	120	60	60	180.5	726.61	4.03	2.3	Export Lager
Burton		352	24	320	820	44	16	262.5	877.88	3.72	3.5	India Pale Ale
Vienna		163	68	243	216	8	39	199.4	687.08	3.45	1.6	Vienna Lager
London		52	32	104	32	86	34	85.3	261.63	3.07	0.5	British Bitter
Munich		109	21	171	79	2	36	140.3	356.68	2.56	1.1	Oktoberfest
Edinburgh		100	18	160	105	20	45	131.3	323.85	2.47	1.0	Scottish Ale
Dublin		118	4	319	54	12	19	261.7	311.15	1.19	1.2	Dry Stout

Dendrogram
Average Linkage; Correlation Coefficient Distance
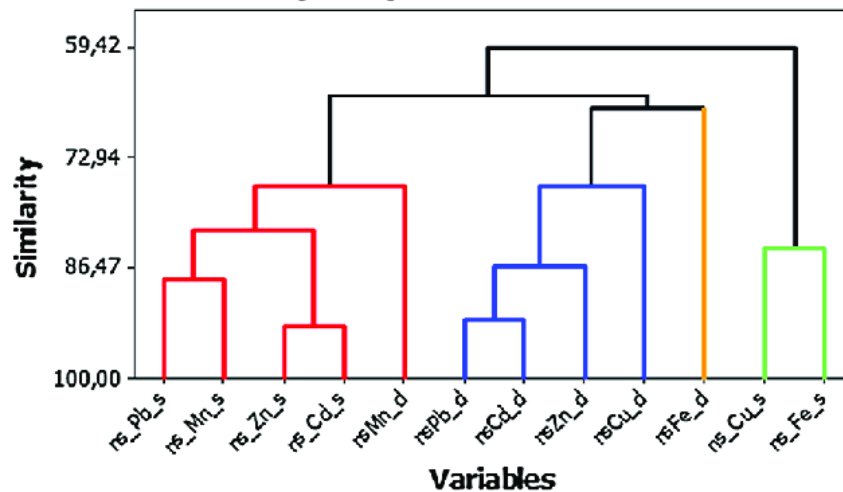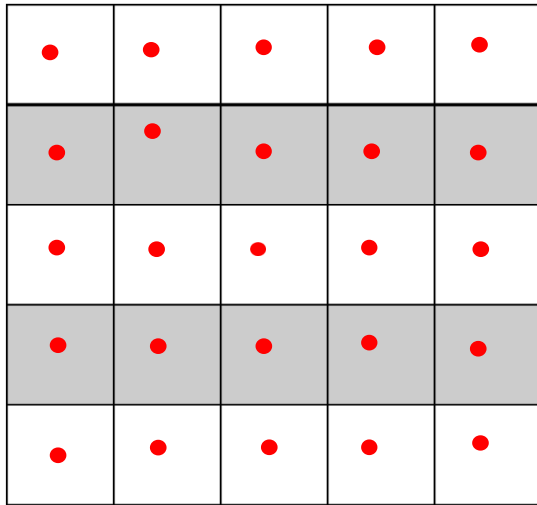
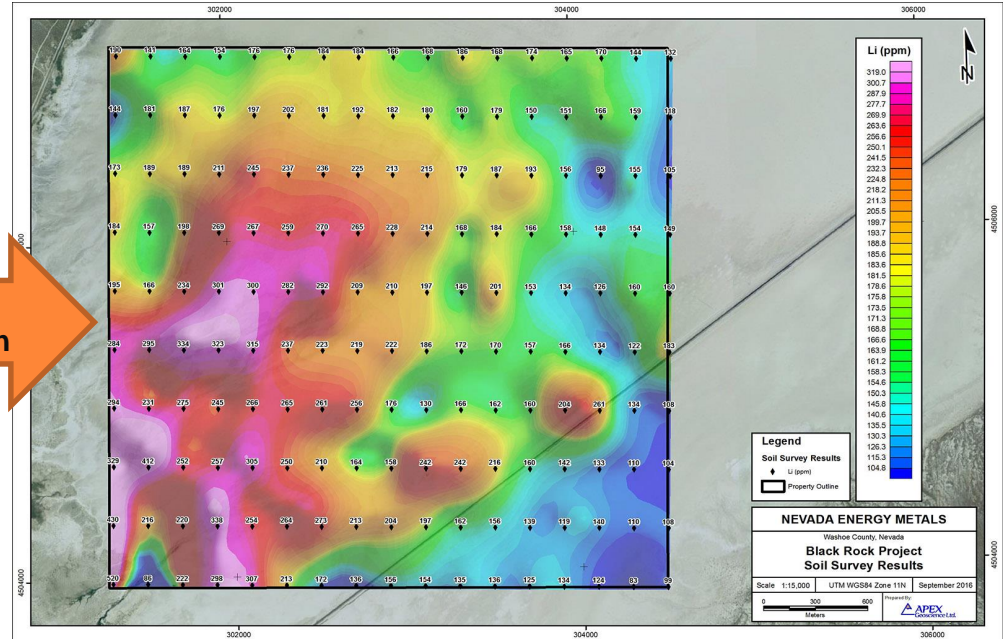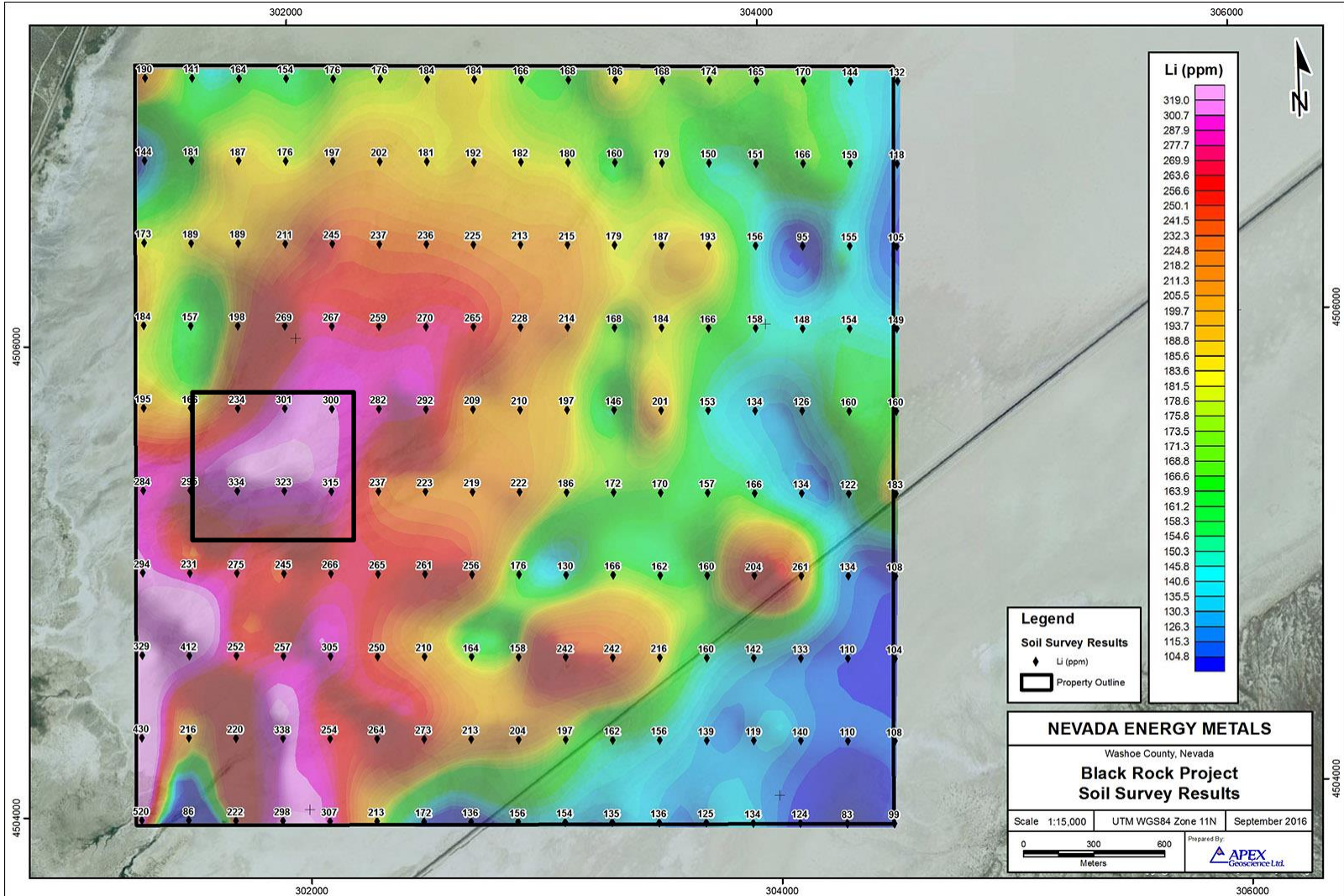# MAP PREPARATION

This project will result in a series of maps on which the distribution of precious and industrial minerals has been plotted

IDENTIFICATION OF PROMISING AREA

AIMS

- *Proposing an effective and wide-sampling method for identification of high potential regions for exploration of precious and industrial minerals*
- *Designing detailed exploration projects in promising areas*
- *Extending the results of study area to regional scale*

All geological surveys and all organization which have traditionally provided data on mineral exploration involve in this project.

To gain data, the GSI relies on cooperation of these organization in the region.

Deserts……

Mysterious lands for exploration

Thanks for Your Kind Attention