Kingdom of Morocco

- Over 90 mining companies
- 20 different mineral products
- 95% of mineral production is Phosphates
- Other metals:
  - Lead
  - Zinc
  - Copper
  - Iron
  - Fluorine
  - Silver
  - Manganese
  - Cobalt
  - Antimony
  - Salt
Mining

- **PHOSPHATE**: Khouribga area; single largest producing phosphate mine in the world. (Reserves = 20 Billion tons)
- **SILVER**: Imiter mine, Oriental Anti Atlas mtns
- **COBALT**: Bou Azzer deposit (world’s only primary cobalt deposit).
- **SALT**: Reserves ~ 600 Mill tons; salt deposit is 80m thick in some places; 98.9% pure.
Morocco’s Geology

Africa’s basement rock: Precambrian (4.54-0.57 Ba)

Four structural domains (south to north)

1. **Anti-Atlas**: (S) 1st tectonic deformation in Paleozoic Era (~300 Ma yrs ago) from continental collisions

2. **Atlas Belt**: (W to E) 2nd phase in Mesozoic Era (~65 Ma yrs ago) which separated continents

3. **High Atlas**: 3rd phase in Tertiary Era (~65 – 1.8 Ma yrs ago) Africa-Europe collision

4. **Rif**: (N) extension of Spain at one time; now separated by water.
Morocco: Rif and Anti-Atlas
Morocco: Oil Shale Deposits
Vanadinite

- Belongs to the Apatite group of Phosphates
  - High Vanadium mineral content
- Common in arid climates, famous Mibladen district, Morocco
- Found in lead-bearing ore deposits that are oxidizing (i.e. Galena)
  - A rare mineral crystal in lead or copper mines

Chemical: \( \text{Pb}_5(\text{VO}_4)_3\text{Cl} \)
Crystal System: Hexagonal - Dipyramidal
Cleavage: None
Luminescence: Non-fluorescent
Luster: Adamantine
Streak: Brownish yellow
Aragonite

- Crystal form of calcium carbonate (CaCO₃)
- Formed by biological and physical processes (i.e., precipitation from marine/freshwater; caves)
- Named after Aragon, Spain which used to be connected to Morocco
- Forms naturally in almost all mollusk shells & exoskeleton of corals
- Commonly replaced by calcite in fossils
Azurite

Well-known deposits:
1. Kerrouchene, Khénifra Province, Meknès-Tafilalet, Morocco
2. Touissit Mine – Morocco (Atlas Mountains)

Secondary mineral in oxidized zones of copper ore deposits

Chemical: \( \text{Cu}_3(\text{CO}_3)_2(\text{OH})_2 \) copper carbonate hydroxide
Hardness: 3.5-4
Species is: pre-historic
Luster: vitreous (glossy)
Streak: light blue
Name origin: Persian lazhward means “blue”
References