MOUNTAINS FOR FOOD & WATER

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No Mountains

No Vegetation - Crops, Fruits, Vegetables, Plants, Herbs....

No Drainage System - Rivers, Streams, Dams..& Sub-surface Fresh Water Reservoirs

No Food & Drinkable Water for Humans, Animals, Birds..
PRESENTATION OUTLINE

• The Holy Quran on Mountains for Basic Needs of Human Beings – Food & Water
• Essential Sources of Food
• Essential Factors for Food Providing Sources
• Geological Processes leading to Creation of A Setting Mandatory for the Food Providing Sources
• Conclusion
• More than 1400 years ago, Allah revealed to His Prophet Mohammad (PBUH) through the Holy Quran that Food & Water Resources are dependent on Mountains that He has placed in the Earth

• It was in mid-19th century, when geoscientists started acquiring the basic understanding of the processes that make mountains valuable for living creatures
16:16 - And He has placed mountains in the earth so that they provide you with food, rivers and routes so that you may be rightly guided (or you may find the way to your destination)

[translation by Hazrat Mirza Tahir Ahmad (rt) – 4th Caliph of Promised Massieh (as)]

The word تَمِيدَ is derived from مَادَ, which means to provide food. The word مائِدَة used in the Holy Quran is from the same infinitive.
21:32 - And We have made in the earth mountains so that they provide you with food; and We have made therein wide pathways, that they may be rightly guided (or you may find the way to your destination) [translation by Hazrat Mirza Tahir Ahmad\textsuperscript{rt} (4\textsuperscript{th} caliph of Promised Massieh\textsuperscript{as})]
ESSENTIAL SOURCES OF FOOD

• Staple Crops
  • Cereals: wheat, barley, rye, oats, corn, rice,....
  • Root vegetables: potatoes, cassava....

• Vegetables...

• Fruit trees, plants....

• Flower plants....

• ......
Essential FACTORS for Food Providing Sources
ESSENTIAL FACTORS to keep Food-Providing-Sources Active

Gases (CO2..)  Sunlight  Water  Soil
Soil Components

- **Mineral particles**: Sand, Silt, Clays
- **Nutrients**: Potassium, Calcium, Sulfur...

**Directly linked to Mountains**

*Modified from University of Hawaii*
# Soil – Common Minerals’ Composition

## Sand & Silt:
Quartz / Silica SiO\(_2\)

## Clay:
- **Kaolinite** \([\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4]\),
- **Illite** \([((\text{K},\text{H}_3\text{O})(\text{Al},\text{Mg},\text{Fe})_2(\text{Si},\text{Al})_4\text{O}_{10})((\text{OH})_2]\)
- **Smectite** \([(\text{Na},\text{Ca})_{0.33}(\text{Al},\text{Mg})_2(\text{Si}_4\text{O}_{10})(\text{OH})_2\cdot n\text{H}_2\text{O}]\)

## Soil Texture

<table>
<thead>
<tr>
<th>Soil Texture</th>
<th>Size</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>&gt; 2mm</td>
<td>Mostly Quartz / Silica SiO(_2); could be a mixture of minerals</td>
</tr>
<tr>
<td>Coarse Sand</td>
<td>~ 2mm</td>
<td>Quartz / Silica SiO(_2)</td>
</tr>
<tr>
<td>Fine Sand</td>
<td>&lt; 0.2mm</td>
<td>Quartz / Silica SiO(_2)</td>
</tr>
<tr>
<td>Silt</td>
<td>&lt; 0.02mm</td>
<td>[\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4], [((\text{K},\text{H}_3\text{O})(\text{Al},\text{Mg},\text{Fe})_2(\text{Si},\text{Al})<em>4\text{O}</em>{10})((\text{OH})_2])</td>
</tr>
<tr>
<td>Clay</td>
<td>&lt;0.002mm</td>
<td>[\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4], [((\text{K},\text{H}_3\text{O})(\text{Al},\text{Mg},\text{Fe})_2(\text{Si},\text{Al})<em>4\text{O}</em>{10})((\text{OH})_2])</td>
</tr>
</tbody>
</table>

![Soil Texture: Sand, Silt & Clay](image)
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**Earth’s Layers → Source Material for Soil**

**Composed of igneous rocks rich in Iron and Magnesium Silicates like basalt**

**Asthenosphere:**
- Temp > 1300 deg C
- 80-200 km below the earth surface
- Average thickness 700 km
- Plastic/viscous layer
- Very rich in Fe, Mg bearing minerals

Olivine (Fe$_2$SiO$_4$-Mg$_2$SiO$_4$)  
Pyroxene (MgSiO$_3$-FeSiO$_3$)

**Crust 0-100 km thick**

**Oceanic Crust**

**Continental Crust**

**Lithosphere** (crust and upper-most solid mantle)

**Mantle**

**Core**

**Solid**

**Liquid**

**Outer core**

**Inner core**

**To scale**

**Not to scale**

**Schematic showing layers comprising internal structure of the Earth – Courtesy of USGS**

**Composed of igneous rocks rich in Calcium, Sodium, Potassium and Aluminium Silicates like Granite**

**Common Feldspar Minerals:**
- Anorthite (CaAl$_2$Si$_2$O$_8$)
- Albite (NaAlSi$_3$O$_8$)
- Orthoclase (KAlSi$_3$O$_8$)

**…….**

**Crustal material contains lighter elements like Si, O, Al, Ca, K, Na, etc..**
Processes causing the Lava / Magma move to the Earth’s Surface & Sea Floor

Oceanic-oceanic plates’ convergence causing formation of volcanic mountains (seamounts and island arcs) on the seafloor - (modified from USGS)

Oceanic crust
Continental crust
Asthenosphere
Continental crust
Lithosphere

A string of volcanic mountains exists around the edges of the Pacific Ocean; thus known as Ring of Fire - (courtesy of USGS)

Basement rocks - solidified lava/magma
Sediments containing water, oil & gas

Continental-oceanic plates’ convergence causing formation of volcanic mountains on the surface of continental crust - (modified from USGS)

Two diverging oceanic plates in opposite directions causing formation of mid-oceanic ridge like the Mid-Atlantic ridge...

Example: Andes Mountains – 7000km long

Example: Hawaii Island
Magma Cooling -> Variety of Mineral Assemblages Crystallize out at different temperatures

<table>
<thead>
<tr>
<th>Temperature Regimes</th>
<th>Bowen's Reaction Series</th>
<th>Composition (rock types)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High temperature (first to crystallize)</td>
<td>Olivine ($\text{Fe}_2\text{SiO}_4 - \text{Mg}_2\text{SiO}_4$)</td>
<td>Ultramafic (peridotite/komatiite)</td>
</tr>
<tr>
<td></td>
<td>Pyroxene ($\text{MgSiO}_3 - \text{FeSiO}_3$)</td>
<td>Mafic (gabbro/basalt)</td>
</tr>
<tr>
<td></td>
<td>Amphibole</td>
<td>Intermediate (diorite/andesite)</td>
</tr>
<tr>
<td></td>
<td>Biotite: $\text{K}((\text{Mg,Fe})_3\text{AlSi}<em>3\text{O}</em>{10})(\text{F,OH})_2$</td>
<td>Felsic (granite/rhyolite)</td>
</tr>
<tr>
<td></td>
<td>Muscovite: $\text{KAl}_3(\text{AlSi}<em>3\text{O}</em>{10})(\text{F,OH})_2$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sodium-rich Amphibole</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calcium-rich Amphibole</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calcium-rich Plagioclase feldspar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sodium-rich Plagioclase feldspar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calcium-rich Potassium feldspar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sodium-rich Muscovite mica</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calcium-rich Biotite mica</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sodium-rich KAl$_3$Si$_2$O$_8$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calcium-rich CaAl$_2$Si$_2$O$_8$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sodium-rich NaAlSi$_3$O$_8$</td>
<td></td>
</tr>
<tr>
<td>Low temperature (last to crystallize)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Amphibole Minerals Group
$A_{0-1}B_2C_5T_8O_{22}(\text{OH, F, Cl})_2$
where $A = \text{Na, K}; B = \text{Na, Zn, Li, Ca, Mn, Fe}^{2+}, \text{Mg}; C = \text{Mg, Fe}^{2+}, \text{Mn, Al, Fe}^{3+}, \text{Ti}, \text{Zn, Cr};$ and $T = \text{Si, Al, Ti}$. 

Biotite:
$\text{K}((\text{Mg,Fe})_3\text{AlSi}_3\text{O}_{10})(\text{F,OH})_2$

Muscovite:
$\text{KAl}_3(\text{AlSi}_3\text{O}_{10})(\text{F,OH})_2$
Magma / Igneous Rock Minerals Transform to **Soil Minerals**

**Coarse Grained Granite:** Quartz & K-Feldspar

**Forms under Conditions**
- **High Temperature**
- **High Pressure**
- **Less free water**
- **Less free oxygen**

**Conditions on Earth’s Surface**
- **Low Temperature**
- **Low Pressure**
- **Higher free water**
- **Higher free oxygen**

Mountain Building – Exposes the Granite or Brings it Closer to the Earth’s surface

Triggers Weathering / Alteration Process of Granite By Physical & Chemical Ways

K-Feldspar: Orthoclase (KAlSi$_3$O$_8$)

Quartz: SiO$_2$
Weathering / Alteration Process of Granite to Soil Mineral Particles

Magma / Igneous Rock Minerals Transform to Soil Minerals

Physical / Mechanical Alteration Processes
Disintegration of rocks / minerals by physical / mechanical process

- Abrasion / erosion by wind / water action
- Joints / fractures
- Heat variation – exfoliation
- Frost wedging
- Plant and animals activities...

Chemical Alteration Processes

- **Carbonic acid** – Water reacts with carbon dioxide in the atmosphere
  \[ \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^- \]
- **Hydrolysis** - H⁺ or OH⁻ replaces an ion in the mineral

$$4\text{KAlSi}_3\text{O}_8 + 4\text{H}^+ + 2\text{H}_2\text{O} \rightarrow 4\text{K}^+ + \text{Al}_4\text{Si}_4\text{O}_{10} (\text{OH})_8 + 8\text{SiO}_2$$

Orthoclase

- **Leaching** – ions are removed by dissolution into water; like the K⁺ ion in the above equation
- **Oxidation** - Since free oxygen (O₂) is more common near the Earth’s surface, it may react with minerals to change the oxidation state of an ion. This is more common in Fe (iron) bearing minerals, since Fe can have several oxidation states, Fe, Fe²⁺, Fe³⁺. Deep in the Earth the most common oxidation state of Fe is Fe²⁺

$$3\text{Fe}^+\text{SiO}_3 + 1/2\text{O}_2 \rightarrow \text{Fe}_3\text{O}_4 + 3\text{SiO}_2$$

Pyroxene – Magma mineral

Oxygen

Magnetite

Quartz (Sand / Silt)

SOIL MINERALS
So Rocks / Mineral Assemblages Comprising Mountains are the Main Source of Soil

Examples: Himalayas, Rocky Mountains....
MOUNTAINS AS SOURCE OF WATER

Bow River, Banff National Park, Alberta Canada
Sources of Bow River water

Mountains as Source of Water
Most Bow River waters come from the Rocky Mountains, an area largely protected within parks. East of the mountains, the Bow River flows through foothills and then through rolling prairie. The Bow River also flows through the City of Calgary, home to most of the basin's human residents.
Mountains are Allah’s great Blessing on us. Without them we would have got no ways to get:

- Food
- River / irrigation system
- Valleys to build dams
- Water Reservoirs; even Oil & Gas reservoirs

Conclusion
Thanks for your attention