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A World of Minerals in Your Mobile Device

Mobile phones and other high-technology communications devices could not exist without mineral commodities. More than one-half of all components in a mobile device—including its electronics, display, battery, speakers, and more—are made from mined and semi-processed materials (mineral commodities). Some mineral commodities can be recovered as byproducts during the production and processing of other commodities. As an example, bauxite is mined for its aluminum content, but gallium is recovered during the aluminum production process. The images below show the **ore minerals** (sources) of some mineral commodities that are used to make components of a mobile device. On the reverse side, the map and table depict the major source countries producing some of these mineral commodities along with how these commodities are used in mobile devices. For more information on minerals, visit http://minerals.usgs.gov.

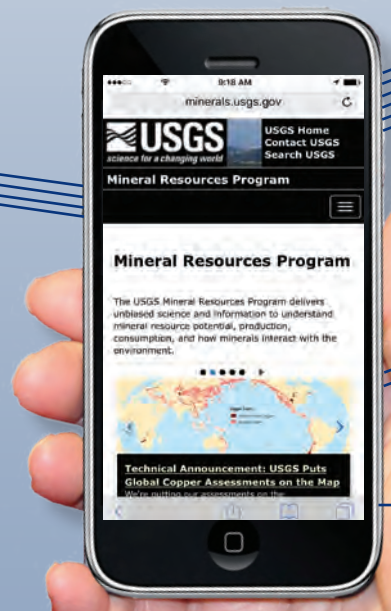
Display

A mobile device's glass screen is very durable because glassmakers combine its main ingredient, **silica** (silicon dioxide or quartz) **sand**, with ceramic materials and then add potassium.

Layers of indium-tin-oxide are used to create transparent circuits in the display. Tin is also the ingredient in circuit board solder, and **cassiterite** is a primary source of tin.

Gallium provides light emitting diode (LED) backlighting. **Bauxite** is the primary source of this commodity.

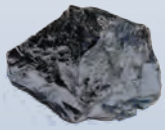
Sphalerite is the source of indium (used in the screen's conductive coating) and germanium (used in displays and LEDs).



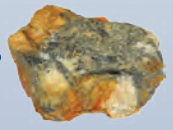
Electronics and Circuitry

The content of copper in a mobile device far exceeds the amount of any other metal. Copper conducts electricity and heat and comes from the source mineral **chalcopyrite**.

Tetrahedrite is a primary source of silver. Silver-based inks on composite boards create electrical pathways through a device.



Silicon, very abundant in the Earth's crust, is produced from the source mineral quartz and is the basis of integrated circuits.

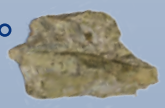


Arsenopyrite is a source of arsenic, which is used in radio frequency and power amplifiers.

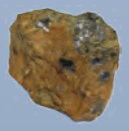
Tantalum, from the source mineral **tantalite**, is added to capacitors to regulate voltage and improve the audio quality of a device.

Wolframite is a source of tungsten, which acts as a heat sink and provides the mass for mobile phone vibration.

Battery



Spodumene and subsurface brines are the sources of lithium used in cathodes of lithium-ion batteries.



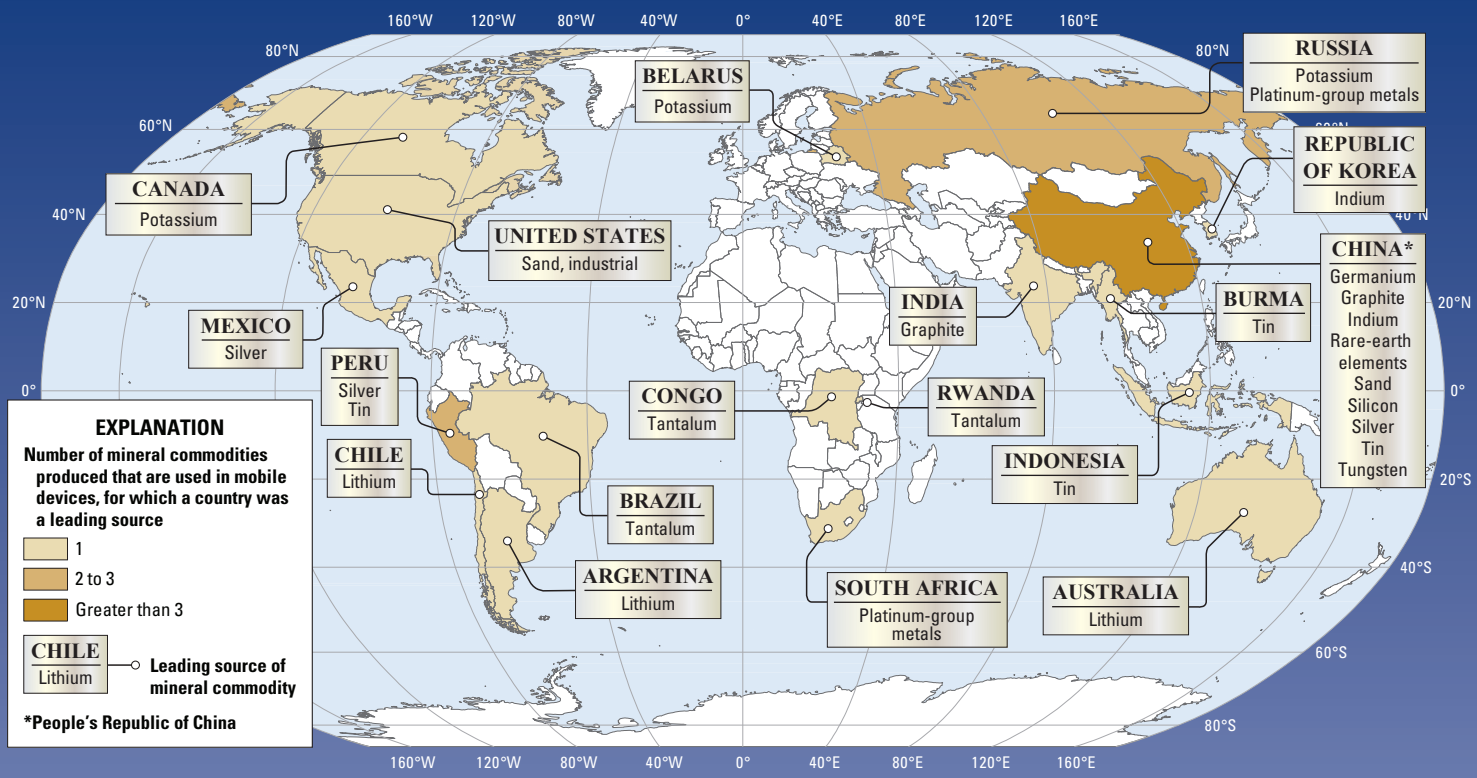
Graphite is used for the anodes of lithium-ion batteries because of its electrical and thermal conductivity.

Speakers and Vibration

Bastnaesite is a source of rare-earth elements used to produce magnets in speakers, microphones, and vibration motors.

Banner image courtesy of freevector-archive.com

Leading sources of mineral commodities used in mobile devices



Examples of mineral commodities used in mobile devices

Mineral commodity	Leading global sources by decreasing tonnage in 2014	Mineral source(s)	Applicable properties of the commodity	Where the commodities are used in a mobile device
Germanium	China[1]	Sphalerite	Conducts electricity	Battery, display, electronics and circuitry, and vibration components.
Graphite	China, India	Graphite	Resists heat, conducts electricity and heat, resists corrosion, and has a high performance-to-weight ratio	Battery anodes.
Indium	China, Republic of Korea	Sphalerite	Transparent and conducts electricity	Liquid crystal displays.
Lithium	Australia, Chile, Argentina, China	Amblygonite, petalite, lepidolite, and spodumene	Chemically reactive and has a high performance-to-weight ratio	Battery cathodes.
Platinum-group metals	South Africa, Russia, Canada	More than 100 different minerals	Conducts electricity	Circuitry, capacitors, and plating.
Potassium	Canada, Russia, Belarus	Langbeinite, sylvite, and sylvinite	Strengthens glass	Screen glass.
Rare-earth elements	China	Bastnäsite, ion adsorption clays, loparite, monazite, and xenotime	Highly magnetic; blue, green, red, and yellow phosphors; and optical-quality glass	LED phosphors, screens, speakers, and vibration motors.
Sand, industrial	China,[2] United States	Silica sand	Gives glass clarity	Screen glass and semiconductors.
Silicon	China	Quartz	Conducts electricity	Semiconductors.
Silver	Mexico, China, Peru	Argentite and tetrahedrite	Conducts electricity	Circuitry.
Tantalum	Rwanda, Brazil, Congo (Kinshasa)	Columbite and tantalite	Stores electrical charge well	Capacitors.
Tin	China, Indonesia, Burma, Peru	Cassiterite	Transparent and conducts electricity	Liquid crystal displays and circuit board solder.
Tungsten	China	Scheelite and wolframite	Highly dense and durable for vibrator's weight component	Vibrator.

[1]People's Republic of China, hereinafter referred to as China.

[2]China is the world's largest producer of industrial sand; however, available information is inadequate to formulate a reliable estimate of output levels.

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