11.6: Anthrospheric Influences on the Geosphere

The urge to “dig in the dirt” and alter Earth surfaces seems to be innate in humans. During recent decades the potential of humans to alter the geosphere has been greatly increased by the development of massive earth-moving equipment. Flooding of rivers caused by human activities was discussed above. Other geospheric disturbances that can be detrimental include landslides on mounds of waste mine tailings, adverse effects resulting from exposure of minerals during mining (production of acid mine water from exposure of pyrite, FeS_2, in coal mining), and filling and destruction of wetlands upon which many forms of wildlife depend for breeding grounds.

Human effects upon the geosphere can be both direct and indirect. Construction of dams and reservoirs, flattening whole mountain tops to get to underground coal seams, and plowing natural prairies to grow crops are obvious direct effects. Indirect effects include pumping so much water from underground aquifers that the ground subsides, or exposing minerals to the atmosphere by strip mining so that the minerals undergo weathering to produce polluted acidic water. In extracting minerals from the earth, it is disturbed and rearranged in ways that can cause almost irreversible damage to the environment. A major objective of the practice of green chemistry and industrial ecology is to minimize these detrimental effects and, to the extent possible, eliminate them entirely.

Many of the effects of human activities on the geosphere have to do with the extraction of resources of various kinds from Earth’s crust. These may range from gravel simply scooped from pits on Earth’s surface to precious metals at such low concentrations that tons of ore must be processed to get a gram or less of the metal. The most straightforward means of obtaining materials from Earth’s crust is surface mining. This often involves removing unusable material in the form of the overburden of soil and rock that covers the desired resource. This may leave a pit that fills with water alongside a pile of the overburden. This kind of mining practice caused many environmental problems in the past. With the modern practice of surface mining, however, topsoil is first removed and stored, rock removed to get to the resource is either placed back in the pit or on contoured piles, and the topsoil placed over it for revegetation. In favorable cases, the result can be attractive lakes that support fish life and vegetated, gently sloping artificial hills.

Underground mining usually does not leave the visible scars that may be inflicted by surface mining. However, it can have profound environmental effects. Collapse of underground mines can cause surface subsidence. Water flowing through and from underground mines can pick up water pollutants. Most ores require a degree of beneficiation in which the usable portion of the ore is concentrated, leaving piles of tailings. These may collapse, and materials leached from them can pollute water. Examples of the latter include acidic water produced by the action of bacteria on iron pyrite, FeS_2, removed from coal and radium leached from the tailings remaining from uranium mining operations.