

REVIEW GEOG 203

Rocks:

- **Endogenic:** internal in earth
- **Exogenic:** external to earth.
- Oxygen and silicon make up 75% of earth's crust. Therefore crust is made up of majority silicates. There are also oxides, sulphides and sulphates and carbonates.
- **Mineral:** inorganic natural compound possessing a crystalline structure.
- **Igneous:** solidified and crystallized from molten state (magma) intruding into rocks or extruding onto surface (lava). Intrusive rocks cooling slowly in crust are *plutons*. *Batholith:* large pluton, making up several mountain chains. Plutons cutting through layers of rock vertically are *dikes* and horizontally are *sills*. Categorized into Felsic (light in color, less dense, low melting point) like granite, rhyolite, pumice and obsidian; and Mafic (opposite) like basalt (cooled extrusive lava).
- **metamorphic:** hard, weather-resistant rocks formed through intense pressure and heat. Occurs along tectonic ridges, at bottom layers of sediment, and in rocks adjacent to magma.
- **sedimentary:** driven by solar energy and gravity. Eroded/weathered then transported through water/wind/ice/gravity to sediment sites where it is buried and *lithified* through cementation/compaction/hardening. Examples: sandstone, shale, and limestone. *Clastic* deposits from weathered rock bits coming together and lithifying. *Chemical sedimentary rocks* form when dissolved minerals are transported in solution then precipitated as organic or non-organic materials. *Evaporites* form when water evaporates leaving salts behind. *Hydrothermal deposits* from mineral-laden hot spring water hitting colder water and forming rocks.
- Iron/magnesium/sodium/potassium rich minerals most easily weathered.

Weathering:

- **Denudation:** a process that wears away or deforms landscape.
- **Differential weathering:** resistant rock strata that protect weaker ones from being carved by weathering
- **Physical weathering:** physical disintegration of rocks by decreasing particle size, increasing surface area. Ex: freeze-thaw (water moves to freeze-front and expands), thermal changes (in sunlit areas, when minerals expand at dif rates), wetting/drying (clays expand when wet), biological (root penetration, worms), pressure release (igneous rocks exposed at surface), salt weathering (form and growth of salt crystals). Affected by variation in temp, water, and biological factors. Dry Cold.
- **Chemical weathering:** chemical transformation of minerals into new products. Usually process making insoluble minerals soluble. Ex: direct solution (dissolution of soluble salts), hydration (absorption of water), oxidation (change in valency), chelation (normally insoluble reacts with organic decomposing matter), carbonation (carbonic acid with carbonates), hydrolysis (H^+ ion with cation in mineral). Facilitated by high temp, acidity, and high biological activity. Wet Hot.
- Strength of rocks igneous > metamorphic > sediment

Soil:

- Role in mediating: *Atmosphere*: absorbs SW, emits LW, albedo, sensible heat, latent heat. *Hydrology*: precipitation infiltration, retention thru saturation/field cap/wilt point/drain.
- Importance of soil texture: influences infiltration rate/overland flow/erosion/permeability, controls availability of water for plants and evaporation, influences soil structure, provides cation exchange capacity.
- Decomposition of organic material controlled by: temperature, precip, type of plant tissue (N and P decompose quickly), fauna.
- Importance of organic matter in soils: improves soil structure and porosity, increases infil rate, increases water capacity, supplies nutrients to plants, cation exchange capacity, buffering against acid rain.
- Nutrient cycling: IN: weathering of minerals, decay of vegetation, atmosphere. OUT: vegetation, atmosphere, water through leaching.
- Soil-forming factors: climate, parent mineral, vegetation, topography, time.
- Arctic brown soils: shallow, weak chemical development, horizon formation underlain by permafrost
- Podzol soils: acid, strongly leached, distinct horizons from Fe and org matter transport.
- Brunisol: fertile, slightly acid, clay-rich.
- Chernozem (black earth): thick surface layer, very limited leaching of bases, neutral pH, fertile for grain crops.
- Peat: under waterlogged anaerobic cold conditions. Slow decomp rates, buildup. Drainage of peat bogs is irreversible.

Biogeochemical cycling:

- In forests Ca is usually lost, N is usually gained, and P is neutral.
- Ease of loss $N > K > Ca > P$.
- Base cations Ca, Mg, K. derived from weathering, precipitation, decomposing organics,
- N has limited adsorption. Nitrates and ammonia in soils. Input from acid rain precip. Ammonia (stored well) converted to nitrate (weakly held) in nitrification, which makes acidic soils neutral. Nitrogen fixation: incorporation of N_2 from atoms. Mineralization: decomp of organics to mineralize N as ammonia. Denitrification: NO_3 to N_2 and nitrous oxide.
- Forest cycling: S as sulphate, Cl as tracer, H contributes to acidity.
- Problems of N in agriculture: groundwater contamination, eutrophication, acid rain, stratospheric ozone depletion, climate change (LW rad absorb). Need to find ways to stop it via denitrification sites along Mississippi river, ideally w/o creating nitrous oxide.

Deforestation:

- Impacts of deforestation: changes in climate from less latent energy, changes in hydrology (red intercept, red evapotrans, inc overland flow, inc discharge), increased sediment transfer, increased erosion, change in stream properties (thermal regime,

sediment concentration, biota), greater variety in ground temperatures, ammonia can't go back into plant life, increased nutrient movement (25% of N and Ca, 58% of K)

- In Oregon clearcut forest there was less change in export than huge changes from HBEF due to: deeper soils, trash burnt releasing N to atmosphere, summer dry period, rapid regrowth.
- Management to reduce effects of clearcut: only sites with thick, fertile soil; small size cuts to encourage rapid regrowth; reduce road density; leave 5-10m strip around rivers; leave successional plant species; leave 100 years for harvest rotation to allow recovery of nutrients.

Acid Precipitation:

- First noticed near coal plants in 1840. In 1970's laws were changed to reduce N and S by 30% due to cross-border pollution.
- **causes of acid precipitation:** oxidation of oxides of S and N. sulphur dioxide to sulphuric acid and nitric oxide to nitric acid.
- **Distribution of Acid precipitation:** geograph pattern function of sources of gases, measured as concentration or flux.
- **Enviro effects of acid precipitation:** coastal eutrophication, mercury accumulation, decreased visibility, climate change, tropospheric ozone.
- **Effects of acid precip on crop yields:** not all crops show change, mustard/radish/beet/broccoli/carrot reduced yields, strawberry/tomato/pepper/alfalfa/pasture grasses. Change in pH of soil corrected cheaply by lime, and N and S are free fertilizers.
- **Effects of acid precip on forests:** long-term cumulative effect, fertilization by N and S, changes in soil properties, lesions on foliage and susceptibility to insects, N₂ fixation inhibited, reduced bacterial and fungal activity, mobilization of toxic elements, hard to attribute damage to acid precip and most remedial action not possible. Once tipped toward acidity it takes a long time to go back to normal.
- Buffering capacity of soil related to: presence of carbonates, cation exchange capacity (dependent on clay), base saturation (pH of soil).
- **Effect of acid precip on aquatic systems:** increased acidity of surface waters, decreased acid neutralization capacity, increased Al ions, increased Al and Ca and pH acidity affect fish life function when lower than 5.5/6.
- It's hard to know how to tackle these things because reactions to repair schemes are diverse. Depends on base cation reserves in soil – which are mostly depleted – soil type, etc. Could take a long time to correct acidic lakes, forest, and crop lands.

Soil erosion:

- Types: soil creep (slow downslope movement from disturbances), landslides and earthflows (rapid movement when soil strength exceeded by gravity), Aeolian (wind removal of surface layer of dry soils), fluvial (by running water).
- Problems with measuring erosion: temporal/spatial variability, labor-intensive, difficult to scale up, of little predictive value.

- Universal Soil Loss Equation: $A = R \times K \times LS \times C \times P$ where A = erosion rate ($\text{ton ha}^{-1} \text{ yr}^{-1}$), R = rainfall erosivity, K = soil erodibility, LS = length and slope, C = crop type, P = conservation measures applied.
- Rainfall erosivity: comb of rainfall intensity and energy (ability to splash soil particles downslope and destroy soil aggregates)
- Soil Erodibility: combo of soil infil rate, ease of detachment, ease of transport.
- **Slope Length Factor:** long slope = faster, thicker; steeper = faster, carrying more.
- **Tolerable erosion rates:** about 1 ton yr⁻¹ ha⁻¹ in developed countries and 10-20 in developing countries.
- **Strategies to reduce erosion rates:** change C, protect soil w/ mulch or reduced tilling, change L-S, reduce grazing intensities.
- **Costs of conservation:** 200-400 person days to build terraces and 50 to maintain, land tenure, farmer recognition, economic long term advantages, knowledge, community vision of benefits of sustainability.
- **Enviro effects of accelerated erosion:** reduced water from soil, increased surface runoff, removes finer particles, reduced soil fertility, loss of fertilizers, shallows soils, gully creation, greater energy costs to farm. **Positive feedback.** Sediments in rivers/dams, eutrophication of water bodies, deterioration of water quality, increased frequency of flooding.
- **Controls on sediment load of rivers:** size and relative topography of drainage basin, effective precipitation or runoff, percentage of basin in cropland, changes in land use like urbanization.

Commanding Heights documentary notes

Episode 1: The Battle of Ideas Friedrich Hayek and John Maynard Keynes were contemporaries and economists with rival views. Their two schools of thought dominated Western economic theory in the 20th century. Each had their period of dominance over the mainstream. Hayek was a believer in free markets whereas Keynes believed in strong government regulation of markets. Lenin opposed international trade and only wanted the USSR to trade with fellow Communist nations.

He was therefore against the “global economy.”

Keynes was a prominent economic advisor to the British government during and after WWI. He strongly opposed the Treaty of Versailles terms that forced Germany to make ruinous war reparations to the Allies because he saw it would destroy their economy, which in turn would lead to sociopolitical instability.

During this period, Hayek became a central member of the “Austrian school” of economics. This was a small group of free market economists that formed in Vienna after WWI. They were marginalized during this period.

Lenin’s hardcore Communist policies were a disaster in the USSR: Food production and industrial output virtually collapsed and the country started falling apart. He had to abandon the most extreme Communist practices early on because they just didn’t work in real life.

Stalin introduced the economic practice of central planning to the USSR. As Hayek predicted, German hyperinflation after WWI completely destroyed the value of all personal bank accounts and bonds held by average Germans. The hard-earned savings of millions of middle- and working-class Germans were wiped out. The German mainstream became outraged and desperate, and they blamed the democratic Weimar government for the problems and became open to extremist alternatives, such as Communism and Nazism. [In Mein Kampf, Hitler cited broad-based anger over German hyperinflation as one of the key enablers behind his rise to power.] In retrospect, the U.S. stock market was in a classic bubble leading up to the 1929 Crash. Of special note were radio company stocks, which can be thought of as “tech stocks” or “dotcom stocks” of the 1920’s: As soon as a radio company went public, speculative investors bid its stock price up to absurd levels that were totally disconnected from the company’s real-world profitability and long-term business potential. U.S. banks had invested their patrons’ deposits in the stock market so they could earn the biggest returns on their money. When the market crashed, much of the banks’ money therefore evaporated. Average people became afraid that the banks would shut down as a result, taking all their savings with them, so they scrambled to go to their banks and withdraw all their cash. Thus, “runs” on banks happened. Between the stock market losses and average people closing down their accounts, many banks basically ran out of money and went out of business, and the personal savings of millions of Americans were destroyed, as was the case in Germany. FDR imposed heavy regulation on the U.S. economy to

finally end the violent boom-bust cycles that had characterized it for decades and now culminated with the Great Depression. During the Great Depression, the economic activity in every country became very low: Consumers were too poor and too scared of losing their remaining money to buy goods or services. Since no one was buying anything anymore, many businesses shut down or had to fire workers in order to save money. Tens of millions of workers were laid off as a result and lost their income and hence money. These laid off workers were also consumers. Consumers were too poor and too scared of losing their remaining money to buy goods or services.

. Each country became locked into a disastrous cycle where neither consumers nor businesses had the money or will to “break out” of the situation. The Free Market had failed to deliver growth and prosperity. Keynes believed that increased government spending could end the Great Depression and restore economic growth. The government could print new money or borrow money from other countries and use it for mass purchases of goods and services from private firms, and it could also directly hire millions of new federal workers and pay them to build public works or perform other government functions. The government could therefore artificially inject massive amounts of money and jobs into the economy, which would break the aforementioned negative cycle that characterized the Great Depression. Keynes believed that it was OK for governments to finance this stimulatory spending by running budget deficits. As the overall economy improved, the governments would slowly decrease their spending, balance their budgets, and start paying off their debts, and the economy would shift back to being dominated by the private sector.

Though many governments implemented some of Keynes’ reforms, it wasn’t until the WWII national rearmament programs that Western countries made the full level of commitment that Keynes envisioned. Around WWII, Hayek was much less influential than Keynes, but he published his seminal economic work:

The Road to Serfdom

. Today considered one of the most influential economic texts in history, it postulated that economic freedom and personal freedom were inextricably linked, and therefore that government control over the economy would inevitably lead to the destruction of civil liberties. Hayek saw government regulation of the economy as a grave, long-term threat to freedom and democracy and he encouraged people to resist. The mass unemployment and lethargic business output that defined the Great Depression disappeared during WWII as everyone got jobs either fighting in the military or making weapons, and as factories were upgraded, expanded and built new in order to produce the necessary war materiel. However, as the War was coming to a close, the Allies began to worry that the Great Depression would come back once the armies were disbanded and the war factories were shut down. Many of them seriously feared that Capitalism was a fundamentally broken economic system that would start failing again once WWII ended, and that Communism would prove superior and would slowly take over the world. To prevent that nightmare, the Allies developed the Bretton Woods System, which was a series of economic and financial agreements in which they agreed to maintain healthy trade with each other, to give each other loans to help save weaker countries having problems, and to heavily regulate their currency exchange rates. The International Monetary Fund (IMF) and World Bank were created as part of Bretton Woods. Though it would take several years for this to become apparent, the

Bretton Woods system indeed saved the Western World from backsliding into depression and in fact inaugurated a long period of explosive economic growth.

During WWII, Britain's various political parties put aside their differences in order to fight the war, but as the conflict was coming to a close, old divisions reemerged. In 1945, there was a general election.

Winston Churchill and the conservatives were running against the socialist Labour Party. Labour's social and economic policies were heavily in line with Keynesianism, which resonated more strongly with most Britons, who were paranoid of returning to economic depression once the War ended. Thus, though Churchill was an undisputed war hero, he and his party lost the election in a landslide. The Labour Party nationalized key industries such as coal and steel production and railroad transit. Profits from these and from private industries were more heavily redistributed to average people. Taxes were increased on the rich, the welfare state was greatly strengthened, and Britain switched to universal health care in the form of the National Health Service (NHS). Many laws were passed also strengthening workers rights. Britain - which up to this point had been a highly stratified and class-obsessed society was becoming a much more egalitarian country in which all citizens were given a stake. Meanwhile, Hayek continued to hold out on the fringes of economics. He worked hard to keep his free market ethos alive in the minds of people and to maintain his band of international supporters. Wage and price controls are meant to curb inflation, but they usually fail. For example, after WWII, West Germany was controlled by governor from Allied countries, and these governors set economic policies, which included wage and price controls. West Germany's recovery from the War was almost nonexistent until 1948, when the Germans unilaterally cancelled the wage and price controls without permission. The economy quickly stabilized and began growing. From the start of the postwar period, West Germany actually had a freer economy than the U.K., and it experienced significantly faster growth. In 1948, India also gained its independence from the U.K. and had the opportunity to craft its own government and to choose an economic model. It decided upon a unique mix of a democratic political system coupled with a centrally planned economy. In short, after WWII, state controlled economies were on the rise across the world. Even "Capitalist" countries that were against Communism such as the U.S. adopted higher degrees of state control and expansions of the welfare state. In 1950, Hayek became a professor at the University of Chicago. Many like-minded economists and academics gravitated there, and the college became a strong bastion of free market thought. The "Chicago School of Economics" was thus founded as an ideological school of thought that echoed the Austrian School of Economics. These Keynesian policies reliably delivered strong economic growth to Western countries until the 1970's, when stagflation began. This exposed disturbing flaws in the widely accepted Keynesian model since the latter held that high inflation, rising unemployment, and slow economic growth could never all happen at the same time, but it indeed occurred during stagflation. Though Richard Nixon was a conservative, he adopted leftist, Keynesian tactics to fight stagflation, most notably imposing wage and price controls. This improved things in the short term and won him votes in the 1972 election, but in the long term it hurt the economy and of course represented a sell-out against his own party's favored macroeconomic policies. During the 1970's, the U.K. also experienced stagflation and likewise ramped up Keynesian policies to cure it. In fact, it made their situation worse. These problems began convincing the mainstream of economists that a return to

freer economies was needed to restore growth. Hayek's popularity began to rise, and policymakers began considering his ideas.

One aspect of Hayek's philosophy that was very germane to the time was the theory that excessive government regulation of the private sector undermined competition between firms and drove up consumer prices while also shrinking consumer choice. In 1974, after having spent most of his life having his ideas ignored and criticized, Hayek was rewarded with a Nobel Prize in Economics. Margaret Thatcher and Ronald Reagan both believed in Hayek's ideas and made the expected reforms to their countries.

In the 1970's there were a series of major strikes across the U.K. involving unionized workers. Key services and industries relating to such things as coal mining, electricity production and garbage collection shut down for long periods, which caused great suffering for the masses of ordinary people who depended on them. Average Britons slowly turned against the unions and the socialist Labour party that backed them, and they voted in conservative Margaret Thatcher in 1979 to be Prime Minister.

Thatcher realized that many of Britain's state-run enterprises had become inefficient and badly run. The same was also true for private businesses that were propped up by large state subsidies. Thanks either to legally ensured monopoly status or to guarantees of money each year regardless of performance, these firms lacked any incentive to innovate or to improve their operations. Traditional price signals no longer functioned. Thatcher cut the subsidies and privatized several of these big firms early on. This caused a sharp, but temporary increase in unemployment as inefficient enterprises collapsed or downsized upon being exposed to real market forces and their workers were laid off. These workers many of whom were unionized formed a small yet highly vocal opposition to Thatcher that persisted across her term. President Carter at first attempted to cure stagflation with more Keynesian policies, but failed. He made a dramatic change of course in 1979 by appointing Paul Volcker to be chairman of the Federal Reserve. Volcker massively increased interest rates and reduced the money supply, which was the classic albeit painful cure for high inflation. The high interest rates severely reduced the availability of credit, which hurt businesses and farmers and led to many layoffs and bankruptcies. The credit crunch also hurt average people who wanted to buy houses, cars or other expensive goods traditionally paid for with loans. Many different segments of the American population suffered due to these harsh but ultimately necessary policies, and their anger helped translate into an election loss for Carter in 1980. However, the election of Ronald Reagan did not usher in changes to monetary policy: Reagan understood Carter's approach was necessary and that the economic situation was slowly improving thanks to it, so he held Paul Volcker on as Fed Chairman and upheld the tight monetary policy. By 1982, U.S. inflation had returned to much lower levels. Carter suffered for making a courageous choice that Reagan got credit for later on.

Margaret Thatcher's policies were very polarizing, and by 1982 it looked like she would lose that year's election to Labour. Fortunately for her, the Falklands War happened, and Britain's military victory under her leadership boosted her popularity enough to win her the election. Thatcher's free market reforms were thus allowed to continue.

She next targeted some of the U.K.'s biggest and most wasteful nationalized industries for privatization.

The state-run coal mines were her biggest challenge because of the powerful miners union. In spite of their strong protests, Thatcher was able to push through reforms that cut government subsidies for their operations and that destroyed the union's power. Once exposed to market forces, the British coal mines quickly went out of business and British energy companies started buying much cheaper coal imported from other countries. While this benefitted millions of British consumers, the small segment of the British population that depended upon coal mining for jobs was very hard-hit. Entire towns that existed solely thanks to work at nearby coal mines were essentially destroyed as everyone lost their jobs. The social fabric of the set owns was destroyed as people either moved out or just got on welfare and stayed. Crime and substance abuse all increased, and the unemployment-driven depopulation of the towns produced whole streets of abandoned, blighted buildings and houses. This experience typifies the reality of globalism and freer trade, in which liberalized economic policies benefit the vast majority of people in a country a small amount each, a small percent of the people are badly hurt, and the net GDP change to the country is positive.

During the 1980's, the Labour party was forced to moderate and to drop its more hardline socialist stances. The contemporary nature of Reagan's and Thatcher's terms in office was critical for restoring the credibility of the free market. When the rest of the world observed simultaneously economic improvements in both countries thanks to the same sorts of policies, more countries started considering the abandonment of Keynesianism.

This set the stage for major global economic changes in the 1990's.