ROCKS AND THE HUMAN ENVIRONMENT

FROM THE SRI LANKAN CONTEXT

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When the geologist views the environment, perhaps he sees it as a mere point in a very long span of time extending to millions or even billions of years. Such a span has witnessed successions of physical and biological processes and accompanying changes. However, for a layman what matters is the interaction of man with the rock environment rather than the processes that create it.

As such for the layman the following would be of interest:

1. Harnessing of rocks in an effective way for his existence.
2. Location of water and other natural resources associated with rocks such as petroleum and minerals.
3. Geological processes which become geological hazards due to the adverse effects on man and his property. Mass movements such as landslides and sheet floods or tectonic movements resulting in earthquakes or volcanic eruptions are such geological processes.
4. Effect of variation in the composition of earth materials on health.
5. Waste disposal in a manner so as to avert environmental pollution.

Man from his primitive days learnt to harness the rocks for his existence be it to generate fire or for hunting purposes. Perhaps that may be why some basic lithological terms in geology such as flint, cobble

pebble find their origins in the primitive man's vocabulary. Man in his search for a more advanced condition of living naturally with evolution started to search for mineral resources which are found associated with rocks- either soft or hard. With such quests came the digging of wells for water resources in their own living environment rather than searching for water in natural settings such as rivers or springs. Of course, man would have begun to understand the elements of geology during his search for life-giving water in the wells.

From the Sri Lankan viewpoint let us examine how rocks have interacted with the human environment since prehistoric times. The prehistoric (around 1000 B.C) burial sites found in the Ibbankatuwa area near Dambulla suggest that the prehistoric Sri Lankan already knew how to select his rocks at least in shaping their tombs. They have selected rocks from the vicinity and the choice of slabs originating from the joints of the rocks suggest that they had some insight into the structure of the rocks.

With the advent of the Aryan civilisation around 500 B.C, as evidenced by the Buddhist historic sites at Anuradhapura, man has already started to select and work hard granite rocks to transform them to beautiful statues. With time the ancient Sri Lankan seems to have recognized the lithological variations in rocks and their constituents- the minerals. Such evidence could be seen at Pidurangala temple near Sigiriya where the weak zones characterized by easily weathering minerals in the lithological successions have been caved into construct human abodes such as monasteries. The plaster used in the

construction of statues show how the minerals present in rocks such as calcite and quartz have been efficiently used in their manufacture.

Later in the Christian era, the ensemble of the rock environment had been properly harnessed. The amazing pleasure gardens and the rock fortress at Sigiriya bear evidence to the mastering of the rock environment. The caving in of reservoirs on the hill top at Sigiriya and the brick works on the massive bedrocks amply show such mastering. Furthermore, in the construction of the Sigiriya fortress and its complex of buildings, different rock types had been recognised and used. Marble slabs had been used to construct the complex drainage and fountain network of the Sigiriya Royal Garden. In the construction of the dam - motte complex around the fortress, soil and rock material had been mixed perhaps according to specifications based on sound scientific reasoning as witnessed by the uniformity in composition and the durability of such mixtures during several centuries of tropical weathering conditions. The many dams associated with ancient irrigation schemes have been constructed at sites even present day scientists would consider as suitable locations. To quote some specific examples, the modern dam on the Maduru Oya has been constructed at the very same site the ancient Sri Lankans had selected between two ridges separated by a reasonably solid rock basement. The ancient dam at Elahera also had existed at the recently selected site for the new dam.

The water resources were scientifically harnessed by the Sri Lankans for irrigation pruposes. Of late with advanced technology water has been used to generate electricity by damming water courses in the processes joining two rock formations or ridges. Water is

eventually sent down a gradient through a rock tunnel which carries the water downstream to be eventually tapped to generate electricity. The water for drinking purposes is for the most part preserved in the rock environment within the beds or strata which are porous; the so-called aquifers. The water had been recovered by digging shallow wells in the order of one to ten meters. In the present Sri Lankan context water needed for expanding populations in the rural areas of the dry zone are obtained from deep wells or tube wells dug into the hard rocks for depths of more than ten meters. The water is found accumulated in porous formations or in fracture networks occurring in the hard rocks.

Other valuable resources obtained from Sri Lankan rocks are building materials and minerals. Building materials such as weathered rocks (laterite S. kabuk), and fresh rocks are directly quarried from rock formations, whereas, clay, sand and gravel are obtained from present day stream beds or ancient buried beds. The valuable metals present in rock formations such as iron, copper, gold, silver and even mercury had been effectively extracted from the minerals or rocks and subsequently worked to meet the day to day needs and also for decorative purposes. The references to such metallurgical activity are commonly found in ancient Sri Lankan chronicles such as Mahavamsa. Furthermore, the evidence for such work can also be gathered from the names of villages where metals had been recovered or worked viz-Ramboda - (Ram = Gold), Tambawita (Tamba= Copper), Ridiyagama (Ridi = Silver) and Akarahadiya, Akkarawita, Akkaraipattu (akkara or akara meaning mine). A multitute of such names exist in various parts of Sri Lanka where the underlying rocks belong to the Highland series of metasedimentary rocks where such

mineral locations have been reported. Apart from the beneficial effects of the rock environment, man has to suffer from many disasters arising out of the same environment. Some prominent examples are earthquakes, volcanic eruptions and landslides that occur because of them or due to other reasons.

Earthquakes and volcanic eruptions occur mostly in areas where stress from collisions or gliding of tectonic plates is released. The plates constitute the continental or oceanic crusts of the earth's surface which are in constant motion. During this motion the rock plates may glide past one another smoothly whereas at other points they may compress, bend and eventually rupture with catastrophic release of stress causing earthquakes. The people living in regions where collisions and gliding occur are susceptible to danger and the solution is to construct quake-proof buildings. Otherwise earthquakes will continue to cause damage to life and property as it happened recently in Mexico or Columbia, when thousands perished.

At points where the tectonic plates meet one another and dive into earth's hot mantle, the plates melt and the molten material so generated and called magma will rise through weak fissures in the earth's outer layer causing volcanic eruptions. The magma referred to as lava as it flows out on the earth's surface at high speed downslope with massive torrents of mud, ash and hot water as mudflows or landslides could wipe out whole populations. As an example, when in the year 79 A.D., Mount Visuvius erupted, the ancient city of Pompei was buried under twenty feet of ash, and mud that flowed with the lava eventually killing an estimated 20,000 people. The toxic gases such as carbon

dioxide or hydrogen sulphide emanating during volcanic eruptions can be carried away by the wind killing thousands of people as it happened recently (in 1986) at Lake Nios of Cameroon in West Africa and at Mount Pelee in Martinique in 1902 killing 30,000 people.

In Sri Lanka, we have been more fortunate to be away from dangers from volcanic eruptions and earthquakes at least for the time being and in the known period of history. However, we are plagued by constantly occurring killer landslides in the Central Highlands of our country. The landslides occur on moderately steep slopes underlain by weak lithologies - particularly feldspar rich rocks, marble, and highly joined rocks or terrains characterized by lineaments - fractures extending several kilo - meters. Some of the landslides have resulted due to the activities of man which cause the destabilization of the ancient slides which had been in equilibrium. On many occasions it has been a case of man disturbing his rock environment by way of construction of houses, digging drains or cutting roads on landslide-prone terrains. Man should know how to live with the changes of the rock environment as much as he is accustomed to living under changing socio-political, economic or even climatic conditions. Thus in the case of landslides, man should adapt himself to changing conditions to survive in the changing rock environment. A proper understanding of causes leading to landslides would be very essential in such adaptations. Many a landslide in Sri Lanka had occurred subsequent to heavy rains. During such rains which precede the landslide, many signals of an impending landslide go unnoticed due to ignorance. Continuous water springs sprouting out of the floors of muddy hut dwellings, cracks developed on the walls of houses due to slow movement of the ground, slanting trees and telegraphic or electricity poles,

subsidence frequently observed along roads are but a few of those signals. If the signals are properly monitored, much damage to life and property could be averted thus allowing the man to survive in a changing rock environment.