Quadrant II – Transcript and Related Materials

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NOTES:

ARGILLACEOUS ROCKS :
Argillaceous rocks are classified as Sedimentary rocks having grain size 1/256 mm. It Includes
shale, Siltstone, claystone, and mudstone

Classification of Argillaceous Rocks:

Unconsolidated	Consolidated	(Metamorphosed)
Silt	Siltstone	Quartzite
Water+ Mud	Mudstone (unstratified)	argillite (no cleavage)
	Shale (Laminated & fissile)	slate (secondary cleavage after metamorphism)
Clay	Claystone	Argillite

Murdock is a general term for all the above consolidated forms of argillaceous rocks eg. Siltstone, mudstone, claystone, shale, etc).

Murdock's are the most abundant of all lithologies constituting of about 45-55 % of sedimentary rock sequence. Their fine grain makes thin section studies difficult. Many of the constituents are not readily resolved under the microscope. Therefore chemical analysis and X-ray techniques are used for identification of their mineralogy.

Mineral composition:

Mudrocks are made up or clay minerals and silt grade quartz.

Shale: l/ 3rd quartz + 1/3rd clay + 1/3rd other constituents

Shales are distinguished from the mudstones due to their lamination and fissility.

The lamination may be due to

l) Light and dark layers

2) Coarse and fine panicles

3) Carbonate and Silt layers.

Textures and Structures

Fine grained elastic sedimentary rocks do not have wide range of texture and structure like coarser clastic rocks. But some common textures seen are laminations and fissility.

Fissility is a property closely associated with compaction and dewatering which produces an alignment of clay flakes. Silt-stone may also show small-scale current ripples.

MINERAL CONSTITUENTS

l) Clay

2) Quartz

3) Other constituents

QUARTZ: Silt size Quartz

OTHER CONSTITUENTS: Muscovite (common, Biotite, Calcite (Skeletal Debris), Pyrite

CLAY: When silicates of primary crystalline rocks are decomposed by weathering i.e. When feldspars, felspathoids, micas, volcanic glass and Fe-Mg minerals are decomposed one of the main product of their decomposition are clay minerals.

Clay minerals are hydrous aluminosilicates with a sheet or layered structures. They are phyllosilicates like the micas. The sheets of clay minerals are made of two types 1^{st} layer is a layer of silicon — oxygen tetrahedra. 2nd layer consist of alumina or aluminum hydroxide octahedron.

3 of the 4 oxygen atoms in each tetrahedra are shared with adjacent tetrahedra and linked together to form a hexagonal network. Si_2O_5 is the basic unit, [aluminium can replace silicon] atoms). The octahedral unit consists of two sheets of closely placed oxygen or hydroxyls between which octahedrally coordinated Al atom is embedded. The position of Al atom is such that it is equidistant from 6 oxygen (O) or hydroxyls (OH).

Al can be sometimes occupied by Mg^{2+}, Fe layers of Al — O/OH in clay minerals are referred to as Gibbsite layer. Since the mineral Gibbsite Al $(OH)_3$ consists entirely of such layers similarly Mg — O/OH is also referred as Brucite $Mg(OH)_2$.

ISOMORPHOUS SUBSTITUTION

Many times some of the atoms and ions in the silica and alumina sheets are replaced by other atoms and ions. For instance Al in the Alumina sheet replaced partially or completely by, Mg, Fe, Ca, or other similar atoms. Similarly a part of Si —atom in the silica sheet is replaced by atoms like P or Al. Such isomorphous substitution is also responsible for development of different clay minerals.

Clay minerals depending on different stacking can be grouped into 3 structures:

l) Two layer structure (1:1) Eg. Kaolinite group

2) Three layer structure (2:1) Eg. Vermiculite, montmorillonite, illite, chlorite.

3) Mixed layer structure (2 & 3 layer ,combination).

I. TWO LAYER STRUCTURE

These have two layered structure consisting of a silica tetrahedral sheet linked to an alumina octahedral (gibbsite) sheet by common ions O/OH ions. Kaolinite structure does not expand with varying water content.

Kaolinite has a basal spacing i.e. distance between one silica layer and the next is of 7A°

II. THREE LAYER STRUCTURE

In Montmorillonite structure alumina octahedral layer is sandwiched between 2 layers of silica tetrahedra. The 3 layer units of montmorillonite group are loosely held in c- direction with water and cations between them. The basal spacing is 14A (on average), but since it has ability to absorb water molecules the basal spacing changes. Varying from 9.6A (with no adsorbed water) to 21.4A(with water). This is one reason of being called expandable clay.

Vermiculite has a similar structure as Montmorillonite although it is less expandable.

Three layer units may also be held together by K. This is because of the favorable ionic diameter and co-ordination capacity of Potassium (K) binds the structure together so tightly that expansion is impossible. This constitutes the Illite group.

Chlorite also has 3 layer structures, the 3 layer unit is held together by a Brucite layer basal spacing 14 A.

Mixed layer clays are also common. These consist of interleaving of sheets of the common clay. For Eg. Illite — montmorillonite, chlorite — montmorillonite.

BASE EXCHANGE:

It is exchange of ions in solution for those of solid. On contact with solid the solution undergo a change reciprocal to that of the solid. Clay minerals show this property in varying degrees. In general Montmorillonite shows a layer base exchange capacity. Whereas kaolinite has only slight exchange ability. lllite is intermediate is between Loess (unconsolidated) loess is a yellow to buff coloured clastic deposit composed of silt size quartz grains. A distinctive feature is the well sorted nature of silt. They are unconsolidated , unstratified cliff forming angular grains. It is highly porous (42 — 50 %) and can stand remarkably in vertical slope because the angular grains provide an interlocking texture. Loess deposited during late Pleistocene times and covers vast areas of central Europe, Mississipi valley region of the United States, eastern South America and

China. Loess is primarily regarded as an Aeolian deposit but once deposited it can be considerably modified by fluvial reworking and pedogenesis, Calcareous concretions found in loess are called "loess doll" Loess deserts are called "Adyrs"