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Mineralogical composition and textures of sedimentary rocks

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Abstract-

Sedimentary rocks also called secondary rocks, are the types of rocks formed by the accumulation, compaction and consolidation of sediments. These sediments may be derived by decay or weathering of pre- existing rocks in suitable enviornments. These weathered products or sediments are carried to the water bodies such as lakes, oceans, rivers, ponds ect where they accumulate and later by compaction and cementation. Composition of sedimentary rocks is defined in terms of mineralogical or chemical consituents. The chemical and mineralogical composition of Sedimentary rocks is due to the result of complex processes acting on the sediments, that have been originated by the disintegration and weathering of pre existing rocks or by the precipitation of compounds from the solutions or by biological means that is living organisms.

This Chemical composition of rocks is extremely diverse in reflecting the variability of mineralogical composition. The composition of rocks helps in obtaining information such as the knowledge on source area of sedimentary rocks, that is chemical and mineralogical data are useful to obtain information on primary characters of rocks. Secondly information such as post sedimentary transformation of rocks and the sedimentry enviornment of formed rocks can be delinated with the help of chemical and mineralogical data.

Keywords- Sandstone , sedimentary rocks, Arkose, textures.

Introduction-

Sedimentary rocks have an average thickness of about 1800 m on the continents. This thickness is quite variable, however, with some areas, like the Canadian Shield having no cover of sedimentary rocks, and other areas, like the Louisiana and Texas Gulf coasts, having more than 20,000 m of sedimentary rock cover. Still, about 66% of all continental areas have a cover of sedimentary rocks.

there are three major types of sedimentary rocks: that can be grouped by the type of particle found in the rocks.

1. Siliclastic sedimentary rocks form by the accumulation of mostly silicate mineral fragments. These include most sandstones, mud rocks, conglomerates, and breccias.

2. Biochemical sedimentary rocks consist of fragments of particles produced by precipitation from once living organisms. Most of these rocks are limestones and cherts.

3. Chemical sedimentary rocks are formed by direct chemical precipitation from water. While some limestones and cherts may form in this manner, evaporite deposits consisting of halite, gypsum, and other salts are the most common.

95% of all sedimentary rocks consists of sandstones (made up of sand sized fragments), mudrocks (made up of silt and clay sized fragments), and carbonate rocks (made up of mostly calcite, aragonite, or dolomite). Of these, the mudrocks are most abundant, making up about 65% of all sedimentary rocks. Sandstones make up 20 to 25% of all sedimentary rocks, and carbonate rocks account for about 10 to 15% of all carbonate rocks.

Mineralogy of Sedimentary Rocks

Because of their detrital nature, any mineral can occur in a sedimentary rock. Clay minerals, the dominant mineral produced by chemical weathering of rocks, is the most abundant mineral in mudrocks. Quartz, because it is stable under conditions present at the surface of the Earth, and because it is also a product of chemical weathering, is the most abundant mineral in sandstones and the second most abundant mineral in mudrocks. Feldspar is the most common mineral in igneous and metamorphic rocks. Although feldspar eventually breaks down to clay minerals and quartz, it is still the third most abundant mineral in sedimentary rocks. Carbonate minerals, either precipitated directly or by organisms, make up most biochemical and chemical sedimentary rocks, but carbonates are also common in mudrocks and sandstones.

Mineral Composition	Mudrocks %	Sandstones %
Clay minerals	60	5
Quartz	30	65
Feldspar	4	10 - 15
Carbonate minerals	3	<1
Organic matter, hematite, & others	<3	<1

Minerals found in sedimentary rocks can be divided into 2 classes:

- Allogenic minerals - These are formed elsewhere and transported into the area of deposition.
- Authigenic minerals - These are minerals that are formed at the site of deposition, either by direct chemical precipitation or by later diagenetic processes.

Any mineral can be an allogenic mineral, but some are more stable under the conditions present at the Earth's surface than are others. Conditions that are present at the Earth's surface and differ from those where most minerals form are:

- Low Temperature
- Low Pressure
- High free oxygen concentration
- High amounts of free liquid water

The longer a mineral is in the weathering and transportation cycles of sedimentary rock forming processes, the more likely it is to break down to a more stable mineral or disappear altogether. Thus, we can classify sediments on the basis to which they have achieved ***mineralogical maturity*.**

- Mineralogically mature sediments and sedimentary rocks consist entirely of minerals that are stable near the surface. Such sediment is considered to have been in the weathering and transportation cycle for a long amount of time.
- Mineralogically immature sediments and sedimentary rocks consist of a high proportion of unstable minerals. Because such minerals will not survive for a long time in the weathering and transportation cycles,

sediments and rocks with high proportions of these minerals must not have been in the weathering/transportation cycle for long periods of time.

Textures of Sedimentary Rocks

Since most sedimentary rocks are derived by processes of weathering, transportation, deposition, and diagenesis, the textures we find in sediment and sedimentary rocks are dependent on process that occur during each stage. These include:

1. The nature of the source rocks. This determines the original shape of the grains and the mineralogical composition of the original sediment.

2. The strength of the wind or water currents that carry and deposit the sediment. This determines whether or not grains are transported or deposited. The deposition process also controls structures that could be preserved in the sediment and thus give clues to the environment of deposition.
3. The distance transported or time in the transportation process. The longer grains are in the transportation process the more likely they are to change shape and become sorted on the basis of size and mineralogy. This also controls extent to which they break down to stable minerals during the transportation process.
4. Biological activity with the sediment prior to diagenesis. Burrowing organisms can redistribute sediment after it has been deposited, thus erasing some of the clues to the original environment of deposition.
5. The chemical environment under which diagenesis occurs. During diagenesis grains are compacted, new minerals precipitate in the pore spaces, some minerals continue to react to produce new minerals, and some minerals recrystallize. What happens depends on the composition of fluids moving through the rock, the composition of the mineral grains, and the pressure and temperature conditions attained during diagenesis.

♦ ***Clastic texture:*** grains or clasts do not interlock but rather are piled together and cemented. Boundaries of individual grains may be another grain, cement or empty pore space. Overall rock is generally porous and not very dense. Because clasts are only cemented together, grains are relatively easy to “scrape off" using a rock hammer point or metal nail. If the grains are visible, all of the above characteristics may be noted.

♦ ***Microclastic texture:*** This texture is the same as the clastic texture except that the clasts are not visible to the eye. Because the grains are invisible, examining the ease in which grains (silt or clay) may be knocked off is the best test to perform.

♦ ***Bioclastic texture***: The texture is similar to clastic texture except that all of the clasts or grains are fossils.

♦ ***Crystalline texture:*** Crystals are visible and form an interlocking network. Unlike igneous crystalline textures, however, sedimentary crystalline textures are typically formed from one mineral throughout the entire rock.

♦ ***Microcrystalline texture:*** no crystals are visible but the rock is composed of interlocking microscopic crystals. Such rocks are dense and typically nonporous. Microcrystalline rocks break with a characteristic conchoidal fracture. That is, the broken surface may smooth concentric lines resembling the inside of an oyster shell or broken glass.

Textural Maturity

The longer sediment is involved in the transportation cycle, the more time it has to become well-sorted. Similarly, the longer the sediment is transported, the more time is available for grains to lose their rough edges and corners by abrasion. Thus, we consider a texturally mature sediment to be sediment that is well-sorted and well-rounded. Note that sediment tends to become both texturally and mineralogically mature the longer it is in the transportation cycle.

Descriptions of Texture

A complete description of the texture of a sedimentary rock should include statements about each of the factors discussed above. To summarize, these are:

1. Size of the grains.
2. Sorting.
3. Degree of roundness and sphericity of the grains.
4. An estimate of the porosity of the rock.
5. Packing of the grains.
6. A description of the matrix.
7. Induration of the rock.
8. A statement about the textural maturity of the rock.

Review of Work already done on the subject

In early 1960s and 70s major development in analytic techniques in geochemistry contributed greatly in geochemical analysis of sedimentary rocks.Many early researchers provided excellent data for minerals like c,s,b,as,sb,hg and some base and precious metals, these elements are very important in the study of fine grained sedimentary rocks.

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