The Brief Study of Physical Properties of Minerals in Granite Rock of Greater Himalayas

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Abstract: ***The Himalayas, a vast mountain range including the highest peaks in the world, stretch approximately 1500 miles across portion of India, Pakistan, Nepal, Bhutan, Afghanistan and China. The types of rocks and minerals its possesses found in the Himalayas vary widely depending upon their specific location, but can be classified in to three categories: metamorphic, igneous and sedimentary. Granite is an igneous rock that is found mostly in greater Himalayan region. In this paper the physical properties of rock granite found in greater Himalayas are studied taking in to consideration the various minerals it consists of. Minerals like Plagioclase, Quartz, muscovite, biotite, hornblende etc. of rock granite has been compared for their Physical properties like Color, Streak, lustre,, Specific gravity, structure and forms etc. It has been found that characteristics like Streak, lustre and specific gravity etc they are almost similar whereas in color, cleavage, fracture etc. They varied largely.***

Keywords: Himalayas, Granite, Streak, Specific gravity, Fracture

1. Introduction

The Himalayas, a vast mountain range including the highest peaks in the world, stretch approximately 1500 miles across portion of India, Pakistan, Nepal, Bhutan, Afghanistan and China [1]. The geology of the Himalayas is a record of the most dramatic and visible creations of the immense mountains formed by plate tectonic forces and sculpted by weathering and erosion. The Himalayas are rich in mineral resources, such as fuels, atomic minerals, precious and semiprecious stones and other industrial minerals. Minerals are non - renewable resources and constitute an integral part of the physical component of the environment and physical settings. Mindless mining and blasting could prove dangerous from environment point of view. The few major rocks found in the range of Greater Himalayas are Granite, Limestone, Schists etc [2]. In this paper the physical properties of rock granite found in greater Himalayas are studied taking in to consideration the various minerals it consists of. Minerals like Plagioclase, Quartz, muscovite, biotite, hornblende etc. of rock granite has been compared for their Physical properties like Color, Streak, lustre, Specific gravity, structure and forms etc. It has been found that characteristics like Streak, lustre and specific gravity etc they are almost similar whereas in color, cleavage, fracture etc they varied largely.

Occurrence

The rocks in the greater Himalayas included in this group range widely in mineralogy and texture, but they are commonly associated with one another in the extensive, composite bodies known as batholiths [3]. They all involve much the same problems of origin. Most typically they are found in batholithic bodies, but these bodies themselves vary greatly in form and dimensions, and the larger batholiths, such as the Coast Range batholiths, the Sierra Nevada, and many of the large Precambrian masses, are not homogeneous but complex bodies in which individual units differ mineralogical, texturally, structurally, and chronologically. They are developed most characteristically, but not exclusively in organic belts. The rock granite which is included is still imperfectly known, and there is little doubt that much of our confusion about the nature and origin of the batholiths lies in our lack of knowledge of what constitutes normal and average features and what characteristics are local, erratic and unusual [4 - 5].

Granite Composition

Granite is a coarse grained phetonic rock containing five percent Quartz, Feldspar of which two - thirds or more is Potash Feldspar or albiteoligoclase, and small percentage of biolite, hornblende or other ferromagnetisms [4]. Granite is the most common intrusive rock in Earth's continental crust, it is familiar as a mottled pink, white, gray, and black ornamental stone. It is coarse - to medium - grained. Of these minerals, feldspar predominates, and quartz usually accounts for more than 10 percent. The alkali feldspar are often pink, resulting in the pink granite often used as a decorative stone. Granite crystallizes from silica - rich magmas that are miles deep in Earth's crust [6 - 7]. Many mineral deposits form near crystallizing granite bodies from the hydrothermal solutions that such bodies release [8].

2. Methodology

For each mineral, systematically record as many properties as you can [9]. Often, a drawing will help explanation and description, esp. of textural features. You may be able to determine some or all of the following:

1) % abundance in the section.
2) Grain shape and size, orientation, etc., and textural relationship to other phases present. In metamorphic rocks look for evidence about whether crystals grew before or after structures such as folds or foliation.
3) Relief in PPL. Note the relief relative to the mounting medium at the edge of the slide, but it may also be useful to know relief relative to other minerals, particularly if you know what these are eg "relief high, but lower than garnet"
4) Color in PPL. Noting any pleochroism, and its orientation (eg "pleochroic from pale yellowish - brown

to deep brown; long crystals darkest brown when oriented N - S etc). Note whether grains are clear or turbid, or rich in inclusions.

5) The presence, shape and orientation of any cracks, if present. These may be cleavages, and may show a clear relationship to the shape of crystals, or to one another - show this on a sketch.
6) Under crossed polars find the maximum birefringence. It's probably easiest to use terms like isotropic (black eg garnet); low (greys and whites eg quartz), moderate (up to first order purple eg sillimanite), high (second and third order bright colors e. g. clinopyroxene, olivine, muscovite), and extreme (washed out buff - pink colors eg carbonates). Note the orientation of grains showing the maximum and minimum colors if appropriate. Note any anomalous birefringence colors.
7) Look for any twinning picked out by different birefringence or extinction position. If possible, note its orientation relative to crystal or grain shape.
8) Look for any zoning indicated by differences in color, birefringence or extinction between the cores and margins of grains. It may be simple, or oscillatory.
9) If there are long crystals, or linear cleavage or twin planes, note the extinction angle relative to the feature. Record any irregular extinction which may indicate deformation or lattice strain.
10) Note any evidence of reaction between minerals in the section, or alteration. If you can't identify fine - grained, cruddy alteration, note its color, and whether cores or margins of grains are preferentially attacked, or whether alteration is patchy, or along cracks, or veins etc.
11) Any associated minerals you can definitely identify. Knowing common associations of minerals is a very useful identification tool.
12) Any other odd or notable features.
13) On the basis of the properties measured, and anything you know about the rock type, identify the mineral.

Mineralogy

Plagioclase: Except for the most alkaline members of this group of plutonic rocks, the plagioclases are the most abundant minerals. The plagioclase ranges in composition from andesine to albite. Andesine is found in the more calcic rocks, such as quartz diorite and graodiorite. Sodic oligoclase is the typical plagioclase of granites, and albite is confined chiefly to those types in which the original plagoclase has been altered or to albitized rocks. Zoning is very strongly developed in some quartz diorites and granodiorites, such as those of the Coast Range. The cores of some of the zoned crystals, when not altered, are found to be as calcic as labradorite. The zoning is often oscillatory and may be marked by distinct conformities along the boundaries of some of the zones. Apart from alteration products, plagioclase grains usually are from inclusions. In some granites and granodiorites, rounded grains of grains of quartz are included in the outer rim of the plagioclase grains.

Alkali Feldspar: In normal granites the commonest alkali feldspar is microcline perthite. Orthoclase and perthite orthoclase also are very common constituents of granite, quartz monzonite (adamellite), and granodiorite. Albite is found in albitized members of this group. Anorthoclase is reported, but it is probable that with the exception of near - surface intrusives associated with volcanoes, the mineral in question is cryptoperthite, a feldspar in which inhomogeneity is apparent but the individual potassic and sodic elements cannot be separated optically. A curious feature of the alkali feldspar is that where they have been carefully investigated it is found that both orthoclase and microcline frequently occur in the same rock.

Perthitic intergrowths are extremely variable in their development. In some rocks, complete separation of the albite and potash feldspar has taken place, so that they appear as separate grains. This segregation currently is regarded as due to the recrystallization of normal perthites, although the possibility should not be disintegrated that crystallization of normal perthites contain only a few scattered lenses of albite, although in most instances the perthitic blebs constitute a goodly proportion of the feldspar grain. In coarse - grained perthites, a striking zonal structure is sometimes developed. This may be emphasised by secondary albite, which appears as irregular enlargements of the blebs, irregular veinlets, rims, and comet - like tails extending from the primary grains.

Piagiocase Feldspar

Alkali Feldspar

Quartz: Except in porphyrites and in some rapakivi granites, quartz invariably is anhedral in the rock of this group. It is usually in grains comparable in size to those of the feldspars, except in granulated rocks or along the borders of the larger grains of the rock. Inclusions are abundant in quartz. Most characteristic are liquid inclusions which are usually irregular in shape but many be in the form of negative crystals. Liquid inclusions can be recognized by gas bubbles, some of which show Brownian movement. Many of the inclusions are arranged along more or less distinct planes in the quartz grains. Such inclusion planes are usually are regarded as secondary in origin. Others that are more irregular distributed may well be primary. In some examples from the Coast Range batholith, the cores of quartz grains are rich in inclusions, but the rims of the grains are virtually free of them. It seems reasonable to consider such inclusions as primary. Minerals inclusions also often found in quartz. Most commonly, these appear to be fibrous, acicular minerals with a high refrigence. They are probably rutile. Inclusions of selender tourmaline and apatite crystals are not uncommon. Also, flakes of mica or fibers of amphibole are frequently intergrown with the quartz along the fringes of its grains. The quartz in granites, granodiorites etc is invariably strained, with wandering extinction, except when it is an introduced vein or replacement mineral.

Hornblende

Quartz

Ferromagnesian Minerals: The most common ferromagnesian minerals in the rocks of this group are hornblende and biotite. Pyroxene is of fairly frequent occurrence in the quartz diorites, granodiorites and other more calcic types, usually in company with hornblende and/ or biotite. Hypersthene is a constituent of a peculiar group of rocks, collectively called as “charnockites” but it is questionable if most of these are simple plutonic igneous rocks. They are regarded by many as metamorphic rocks. Alkaline amphiboles and pyroxenes are the distinguishing marks of the alkaline granites.

Other Minerals: Muscovite is a common constituent of granite and are more acid members of this group [10]. It often occurs as patches enclosing biotite. It is questionable whether it is a true pyrogenic mineral. Much muscovite appears to be an alteration product of plagioclase or of inclusions of aluminous material. There is no reason known, however, why it could not be a direct crystallization from a hydrous magma.

Lithium - bearing micas, such as lepidolite and zinnwaldite, are found in some granites (e. g. some of the granites associated with the tin veins of cornwall and saxony). They are more typical of pegmatites, however, and will be more fully discussed in connection with those curious and interesting rocks.

Apatite is universal, although it is not as typical of these as of the more basic intrusives. It occurs as irregular grains and as euhedral crystals. Some, however are dull, with weakened birefringence due to radioactivity damage. Zoned crystals are by no means rare. Zircons frequently are associated with biotite and also occur in association with quartz. Sphene is the most charecteristic accessory of the quartz diorites and granodiorites. It occurs as irregular grains and as euhedral crystals, often of considerable size. Like the other accessories, it is associated with biotite and other ferromagnesians and to some extent with quartz. Rutile is an accessory, occurring as inclusions in quartz also in biotite, particularly where the latter is somewhat altered. Monazite is another accessory commonly encountered in granites. It is distinguished from zircon by its yellowish color and its biaxial character. Allanite is a frequent accessory in rocks of this group. It usually is associated with epidote, so that it is a late mineral. Due to radiation damage, it is usually dark brown in color, often almost isotropic in character, particularly in the older granites.

Muscovite

Lepidolite

Table 1: Physical properties of minerals of rock Granite

Mineral	Muscovite	Lepido- Lite	Horn-Blende	Apatite	Plagio - clase	Quartz
Chemical composition	$KAL_2 (AlSi_2) O_{20} (OH. F_2)$	$KLi_2Al (Si_4O_{10}) (OH F)_2)$	$Ca, Mg, Fe, Na, Al)_{7-8} (Al, Si)_8 O_{22} (OH)_2$	$Ca_5F (PO_4)_2$ or $3Ca_3. P_2O_8, CaF_2$	$NaAlSi_3O_8$ and $CaAl_2S_2 O_8$	$Si O_2$
Color	White, colorless etc.	Rose red, violet gray etc. *	Black or greenish black	Pale sea green, yellowish, brownish	White	Colorless or white
Streak	Uncolored	Uncolored or white	Uncolored	White	Uncolored	Uncolored
Lustre	Vitreous sometimes earthy	Pearly*	Vitreous	Vitreous	Vitreous	Vitreous
Structure & Form	Crystalline tubular, flaky, massive	Aggregate of short prisms, massive scaly, granular.	Crystalline, also occur as blade like prisms or massive*	Massive crystalline	Crystalline prismatic	Crystalline hexa - gonal
Cleavage	Perfect basal one set*	Perfect Basal	Perfect* 2 sets (oblique at 56° - 124°)	Imperfect or poor	Perfect 2 sets*	Absent
Fracture	Very difficult to obtain due to very highly perfect cleavage	Perfect	Uneven	Conchoidal or uneven	Uneven, obtained with difficulty	Conchoidal
Hardness	2 - 2.5*	2.5 - 4*	5 – 6*	5*	6 – 6.5*	7 cannot be scratched by knife*
Specific Gravity (Heaviness)	Light 2.76 - 3.0	Light 2.8 - 2.9	Light 3.3 – 3.7	Light 3.17 – 3.23	Light*2.6 – 2.62	Light 2.65

*asterisks indicate chief distinguishing characters.

3. Results and Discussions

It has been found that although all minerals of rock granite are different in chemical composition. In color muscovite, plagioclase and Quartz are similar but Lepidolite, Hornblende, Apatite are having different colors. For Streak property all are same except Apatite. All are vitreous and crystalline in lustre and Structure except lepidolite. In cleavage all are perfect basal except plagioclase and quartz. Fracture and Hardness property is completely different for all the minerals. In specific property all the minerals fall in light category. High incompatible elements and low High Field Strength Elements (HFSE) of Himalayan Granite indicate major crustal source typical of arc magmas.

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