**Table 1** Important Properties of Heavy minerals

| Name | Composition | Form/Shape | Transparency | Relief | Biref | XL. System | Cleavage | Pleochroism | Extinction | optical Chara | Source | Dict. Features |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Andalusite | $Al_2SiO_5$ | Prismatic | Tranp. to Transl. colourless to pink | Mod | Weak | Orthorhombic | Prism.c | Weak, pale pink to colour | Strt | Biaxial – ive | High rank Met. Sour | Mod relief, weak brief, strt extnc, prismatic cleav colourless to pink pleochr |
| Apatite | $Ca_5(PO_4)_3F$ | Euhedral/Subhedral 6sised prism xls | Transparent, colourless | Mod | Weak whiten X– polars | hexagonal | Imperfect basal {0001} | Absent | Strt | Uniaxial – ive | felsic ig rk | Prismatic form, mod high relief, weak brief, strt extn colorless. |
| Cassiterite | $SnO_2$ | Prismatic/pyramidal Euhedral/Subhedral | Translucent/ Opaque yellowish reddish brown | V high, may show adamantine lustre in reflected light | V high | Tetragonal | Imperfect poor | Occ.Pleochr. In brown or reds | prismatic gr. Show st. extnc | Uniaxial +ive | Veins, granite, pegmatite metallifer. Loads alluvial placers | Form, colour, relief, extinct., biref |
| Epidole | $Ca_2(Al, Fe)_3OH(SiO_4)_3$ | Prismatic Subhedral elongate euhedral | Transparent/ Colourless Fe rich var. may be yellowish | high | Mod strong (Fe cont) | Monoclinic | Perfect{001} Imperfect{100} | Pleochroic in yellowish green | Strt | Biaxial – ive | Erosion of regionally metamorphosed rock | Yell, Gr col, weak pleochr in PPL, high relief mod str biref, st.ext in prism. Grain |
| Garnet | | Circular grains full of inclusions | Transparent. Translucent colourless, pale pink, G Garnet may be yellow, brown or green | Very high | Isotropic | Cubic | | Absent | Absent | | High rank met rk., thermally met rk., reg met rk Ca rich, most marine sed is dtrital, Sp gran Auth origin in marl ooze | Isotopic, high RI, form. absence of cleavage |
| Almandine | $Fe_3Al_2Si_3O1_2$ | | | | | | | | | | | |
| Pyrope | $Mn_3Al_2Si_3O1_2$ | | | | | | | | | | | |
| Speseartie | $Mn_3Al_2Si_3O1_2$ | | | | | | | | | | | |
| Grasaularitte | $Ca_3(Al_2Si_3)12$ | | | | | | | | | | | |
| Andratite | $Ca_3Fe_2Si_3O1_2$ | | | | | | | | | | | |
| kyanine | $Al_2SiO_5$ | Blade flakes, sharply angular, cleavage fragment | Colourless to blue in patches | high | Mod | Triclinic | 3sets perfect{100}, less perfect {1010} parting {001} | | Biaxial, Obidue upto 30 degree{100} | | High rank met sources frq ass with Staurolite granet, andalusite | Colour, grain shape, high relief, conspic cleavage |
| Monazite | (Ce, La, Nd, Pr, $PO_4$) | Prismatic euhedral/subhedral xls or rounded egg shaped grains | Transparent colourless thick grain show brownish colour | Very high | Strong to very strong | Monoclinic | Perfect{001} good{100} | Usually absent thick gr may show yellow pl | 2– 10 degree with c– axis | | Felsic ig rk, sands eroded from granitic hinterland | Form, typically small gr. Size, v high relief. Close resemblance with sphene but has a lower brief |
| Rutile | $TiO_2$ | Prismatic euhedral slightly rounded. Striations Oblique to prism edge due to polysynthetic twinning | Transparent yellow to red brown | Exceptionally high | Extremev high int colour obscured by total reflection Mod | Tetragonal | Parallel to the length of the XI{110} | Feebly pleochr | Strt | Uniaxial +ive | Basic igneous rock | Prismatic form, colour, cleavage, extreme, biref, presence of diagonal striae, high relief |
| Sillimanite | $Al2Si_5$ | Small slender prismatic grain | Transparent , colorless, thick gr. May appear yellow or brownish | | | Orthorhombic | Parallel to the {010} | Absent | Parallel to the prism edge | Biaxial +ive | High rank met source | Sillim distinguished from Andalusite– strong biref. Kyanine– elliman may be same in PPL but St. extn. Low RI, high Int colour |
| Sphene | $CaTiSiO_5$ | Small diamond shaped eu/subhedral freq contain inclusion | Colourless to brown to brownish yellow | Very high | Very strong same as rutile | Monoclinic | {110} distinct | Sometimes pleochr in yellow & brown | Rarely show complete extnc due to dispersion | Biaxial +ive | Felsic ig rk, met rk– hbl schist, amphibolite | Wedge shaped xl. |
| Staurolite | $2Al_2SiO_5Fe(OH)$ | Irrg euhedral gr, serrated edge, gr, Surface etch | Transparent, pale yellow to yellowish brown | High | Weak | Orthorhombic | Prismatic parrl to {010} | Distinct pleochr, pale yellow to med yellow to brown | Prismatic section show strt extnc | Biaxial +ive | High rank met rk– assc with sillim, kya, granet | Colour, high relief, plecohr St. extinction, assoc with other high rank mn |
| Tourrnaline | Complex Al borosilicate | Prismatic eu/ subhedral xls | Transparent wide range of colour | Mod to high | Mod | hexagonal | Absent | Strongly pleochr | Straight | Uniaxial – ive | Acid ig rk blue verity (indicolite) characterized of pegmatite also found in met rk | St extinc, strong pleoch |
| Zircon | $ZrSiO_4$ | Elongate to almost equant euhedral or subhedral xl incl common | Usually colourless transparent Fraint shades of yellow or | Very high | Very strong | Tetragonal | Absent | Absent | Strt | Uniaxial +ive | Felsic ig rk, met rk, indicator of reworked sediments also | XI form, transparency, inclusions, lack of colour St extnc., strong biref V high relief |

brown

**Table 2** heavy mineral variation in the surface sediments of the Indian shelf

| **Minerals** | **Eastern Coast (Surface sample)** | **Western Coast (Surface sample)** |
|---|---|---|
| **(The values indicate the mean percentages based on number counts)** | | |
| Hornblende | 11.68 | 27.97 |
| Pyroxene (Clino) | 1.72 | 2.72 |
| Pyroxene (Ortho) | 1.29 | 1.85 |
| Tremolite/Actinolite | 1.53 | 1.6 |
| Opaque Minerals | 37.83 | 25.02 |
| Chlorite | 1.55 | 1.3 |
| Carbonate | 0.97 | 0.15 |
| Garnet | 7.52 | 1.07 |
| Sillimanite | 5.14 | 1.89 |
| Kyanite | 0.31 | 0.58 |
| Andalusite | 0.02 | 0.06 |
| Epidote | 4.14 | 3.24 |
| Clinozoisite | 0.48 | 0.52 |
| Zircon | 6.51 | 1.8 |
| Monazite | 2.33 | 1.16 |
| Rutile | 0.82 | 0.13 |
| Sphene | 0.04 | 0.14 |
| Apatite | 1.18 | 0.03 |
| Biotite | 4.94 | 1.4 |
| Muscovite | 5.61 | 23.48 |
| Toumaline | 0.21 | 0.11 |
| Glauconite | 3.12 | 0.08 |
| Number of samples | 118 | 152 |

**Table 3** 3–stage depositional model

| | |
|---|---|
| 1. Initial Stage | Supply of Heavy Minerals through rivers and deposition of sand containing disseminated placers by currents, waves etc. |
| 2. Transgressive Stage | Erosion and reworking of beach ridges. |
| 3. Regressive Stage | Formation of placers in beach is due to waves and long shore current activity giving rise to the present configuration. |