DRAINAGE PATTERN

Drainage pattern refers to the particular plan or design which the individual stream courses collectively form. Drainage patterns are controlled by following factors:

1) Initial slope.
2) Lithology and lithological variation.
3) Structures.
4) Geologic and geomorphic history of the area.
5) Climate and rainfall of the area.

Since the drainage patterns are influenced by so many factors they are extremely useful in the interpretation of geomorphic features and for understanding of structural and lithological control of landform evolution. Drainage pattern is an important element in geologic interpretation of aerial photos.

Drainage patterns can be classified into following 4 types depending upon their origin, spatial distribution, sub-surface flow and channel characteristics.

A) GENETIC CLASSIFICATION

It is related to the period of formation and their relation to the original slope, underlying bedrock and structures. Genetically the streams have been divided into following types :-

1] Consequent stream - A stream whose course is dictated by the slope of the land.

2] Sub-sequent stream - A stream that has developed on a weak substructure, such as a clay vale or in regional joint or fault pattern, at right angles to streams consequent to the dip of the slope. Such streams owe their development to the accelerated rate of head-ward erosion of zones of least resistance.

3] Obsequent stream - A stream that flows in the opposite direction to a consequent stream, often against the direction of dip.

4] Resequent stream- A stream which flows down the dip of the formations.

5] Insequent stream - A stream whose course is not controlled by original slope, structure or rock types.

6] Superimposed stream - A stream formed on one surface and structure has science cut down through unconformity to flow over older rocks, which have structure discordant with that above the unconformity. Such a stream is then said to be superimposed on older rocks.

7] Antecedent stream - Established a course despite the appearance and growth of some structural element across its path. e.g. The Indus, the Satluj and the Brahamaputra rivers have cut transverse gorges across the Himalayan mountains. The uplift of Himalayas increased their gradients and their increased erosive action was able to maintain their courses across the mountains.

B) GEOMETRIC CLASSIFICATION

On the basis of the map pattern formed by the stream channels the drainage patterns may be of following types:-

1] Dendritic Pattern - This is the most common pattern and is characterised by irregular branching, haphazard orientation and irregular spacing of the tributaries. This pattern develops on the flat rocks of uniform resistant. Fine textured impervious rocks like shale, clay, tuffs, basalt etc

have such type of pattern developed on them. The development of the dendritic pattern is influenced by the lithological and physical characteristics of the rocks. No structural control.

2] Trellies Pattern - It is characterised by a network of parallel or sub-parallel streams developed along strike and dip directions. Such patterns generally reflect a marked structural control by faults, joints, alternating soft and hard beds etc. Tributaries are at right angle to the main stream. This may be encountered in certain glaciated areas where parallel hills (drumlins) give rise to this pattern.

3] Rectangular Pattern - In this pattern main stream and its tributaries display right angled bands. Streams are flowing in two directions at right angle each other. All the streams have straight courses and abrupt turns. The most usual control is right angled faulting or joints.

4] Angulate Pattern - In this type the streams are developed equally in two directions but streams meet at an acute angle rather than at right angle. This pattern results due to structural control.

5] Radial Pattern - This pattern developes from a central elevated tract such as volcano, dome or doubly plunging anticlines. In this pattern streams diverge radially from a common point.

6] Centripetal Pattern - This pattern is characterised by stream lines converging into a central depression. Found on sinkhole, craters and other basin like depressions.

7] Annular Pattern- Such pattern may be found around maturely dissected domes which have alternating bands of hard and soft rocks encircling them. They have ring like planes. Tributaries follow bands of less resistance.

8] Barbed Pattern - A drainage in which a stream suddenly bends back on itself and flows in an almost reverse direction often due to glacial blocking, river capture or local tectonic movement.

9] Contorted Pattern - Tributaries are more or less parallel but having opposite flow direction than the main stream.

10] Pinnate Pattern - This pattern is characterised by long main stream and closely spaced short tributaries. It looks like feathers. Gullies are broad and flat bottomed. It develop on clay horizons and sandy materials. No structural control.

11] Pectinate Pattern - Parallel gullies with pear shaped head water basins. Common in loess areas or in badland or ravines.

12] Pincer like Pattern - Tributaries of 4th order and 3rd order show pincer like curved form. Develop on hard igneous rocks partly fracture controlled.

C) INTERNAL DRAINAGE -

1] Sinkhole - A hollow oval or circular in outline with short rudimentary channel which disappear in the hole. This is typical of soluble rocks like limestone, gypsum and dolomites etc.

D) SPATIAL DRAINAGE PATTERN -

1] Dichotomic - In this type of drainage pattern streams radiate from a common point in a fan shaped manner. Such patterns develop on alluvial fans and deltas in coarse granular material.

2] Anastomotic - Steams branching and rejoining irregularly. Streams are meandering with ox-bow lakes and meander scars. Common on flood plains.

3] Braided Pattern - A stream consisting of interwoven channels constantly shifting through islands of alluvium and sand banks. Stream beds are wider and shallower. Controlled by deposited material.

4] Deranged - Aimless, erratic and haphazard channels disappearing in swamps and lacunas of the kettle depressions. Develops on glacial till.

DRAINAGE ANAMOLY

A drainage anomaly is a feature of drainage which is different from the normal pattern either in spatial or depth characteristics. These anomalies result from neo-tectonic activity. Drainage anomalies indicate structural features and changes in lithology. An abnormally linear drainage line would suggest a fracture or joint or fault control or contact between a soft and hard formation. An arcuate course may indicate a plunging fold closure or a domal structure. Abrupt change in stream development may indicate recent tectonic changes and rejuvenation.

DRAINAGE ANALYSIS IN GEOLOGIC INTERPRETATION

BASIC	SIGNIFICANCE	MODIFIED BASIC	ADDED SIGNIFICANCE
DENDRITIC	Horizontal sediments or beveled, uniformaly resistant crystalline rocks. Gentle regional slope at present or at the time of drainage inception. Type pattern resemble spreading oak or chestnut tree.	**Subdendritic**	Minor secondary control, generally structural.
		Pinnate	Fine-textured easily erodable materials.
		Anastomotic	Floodplains, deltas and tidal marshes.
		Distributory (Dichotomic)	Alluvial fans and deltas.
PARALLEL	Generally indicates moderate to steep slopes but also found in areas of parallel elongated landforms. All transitions possible between this pattern and type dendritic and trellies.	**Subparallel**	Intermediate slopoes or control by subparallel landforms.
		Colinear	Between lines-loess and sand ridges.
TRELLIES	Dipping or folded sedimentary, volcanic or low grade meta sedimentary rocks; areas of parallel fractures; exposed lake or sea floors ribbed by beach ridges. All transitions to parallel pattern. Type pattern is regarded as one in which small tributaries are essentially same size on opposite side of long parallel subsequent streams.	**Subtrellies**	Parallel elongate landforms.
		Directional Trellies	Gentle homoclines. Gentle slopes with beach ridges
		Recurved Trellies	Plunging folds.
		Fault Trellies	Branching, converging, diverging, and roughly parallel faults.
		Joint Trellies	Straight parallel faults and/or joints.
RECTANGULAR	Joints and or faults at right angles. lacks orderly repetitive quality of trellies pattern; streams and divides lack regional continuity.	**Angular**	Joints and/or faults at other then right angles. A compound rectangular-angulate pattern is common.
RADIAL	Volcanoes, domes and erosion residuals. A complex of radial pattern in a volcanic field might be called multi-radial.	**Centripital**	Craters, calderas and other depressions. A complex of centripital pattern in area of multiple depresion might be called multi-centripital.
ANNULAR	Structural domes and basins, diatremes and possible stocks.		Longer tributaries to annular subsequent streams generally indicate direction of dip and permit distinction between dome and basin.
MULTIBASINAL	Hummocky surfecial deposits; differentially scoured or deflated bedrock bedrock; areas of recent volcanism, limestone solution and permafrost. This descriptive term is suggested for all multiple-depression pattern whose exact origin is not clear.	**Glacially distributed**	Glacial erosion and/or deposition.
		Karst	Limestone.
		Thermokarst	Permafrost.
		Elongate Bay	Coastal plains and deltas.
CONTORTED	Contorted, coarsely layered metamorphic rocks. Dykes, veins and migmatized bands provide the resistant layers in some areas. Pattern differs from recurved trellies in lack of regional orderliness, discontinuity of ridges and valleys and generally smaller scale.		To longer tributaries to curved subsequent streams generally indicate dip of metamorphic layers and permit distinction between plunging anticlines and synclines.