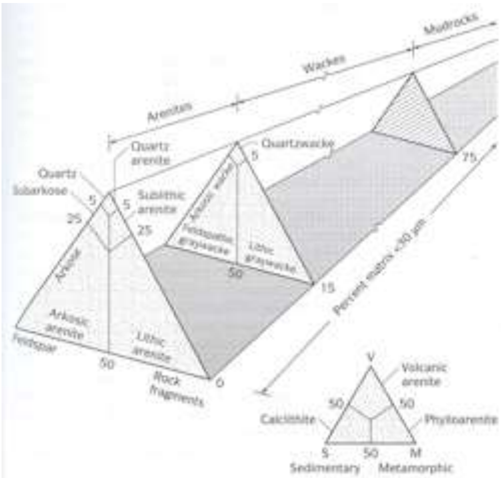
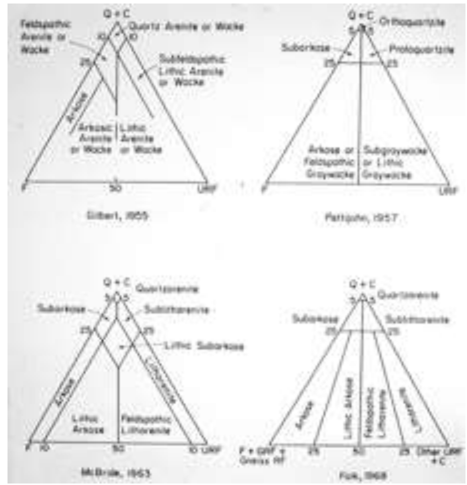
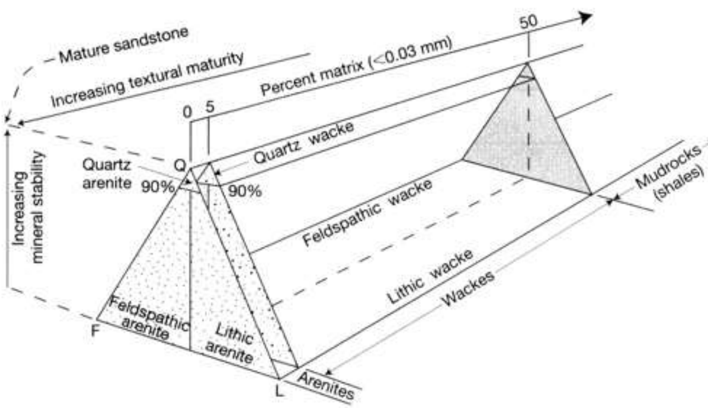
Classification of sandstones

Compiled by S.N.Mohapatra

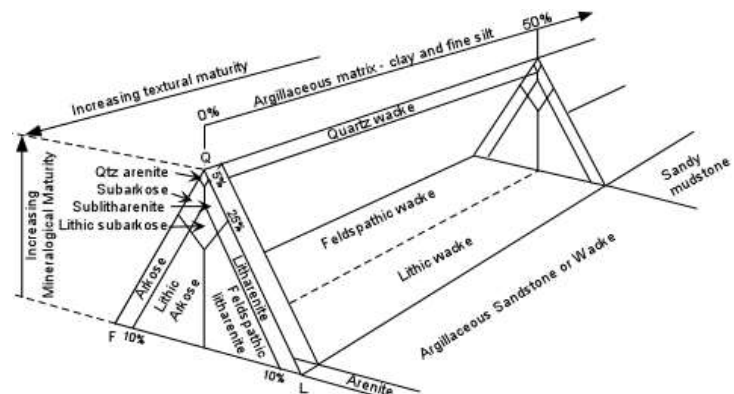




There have been over fifty classification schemes proposed for sandstone. Most of those currently in use involve a ternary QFL (quartz, feldspar, lithic) plot for framework grains and a major division based on the relative amount of matrix.



Dott Classification



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The classification of a sandstone is based on microscopic studies and requires an assessment of the percentages of the various grain types present (shown in Table 2.9). Several hundred grains (400 recommended) are identified by point-counting a slide, and to compare different sandstones, samples of a similar grain size should be used. A rough estimate of this modal composition can be obtained by comparing the sandstone field-of-view with the diagrams of Fig. 2.49, which show the appearance of different percentages of grains in circular and square fields. A very rough estimate only of a sandstone's composition can be made in the field through close scrutiny with a hand-lens.

There are several classification schemes available and most use a triangular diagram with end members of quartz (Q), feldspar (F) and rock fragments (L). The triangle is divided into various fields, and rocks with an appropriate modal analysis are given a particular name. In recent years, the study of sandstone provenance has been taken much further, so that a sandstone composition can be tied more precisely to its source area and tectonic setting. This involves counting all the different types of quartz (Qmnu, Qmu, Qp_{2-3}, $Qp_{>3}$), feldspar (Fk, Fp) and lithic grains (Ls, Lm, Lv) (see Table 2.9) and plotting the results in different ways on several triangular diagrams (see Section 2.8).

Table 2.9 Classification of sand-grain types

Quartzose grains (Qt = Qm + Qp)	
Qt	= total quartz grains
Qm	= monocrystalline quartz
Qp	= polycrystalline quartz
Feldspar grains (F = P + K)	
F	= total feldspar grains
P	= plagioclase grains
K	= potassium feldspar grains
Lithic fragments (Lt = Qp + Lvm + Lsm)	
Lt	= total lithic fragments (L + Qp)
L	= total unstable lithic fragments (Lvm + Lsm)
Lv/Lvm	= volcanic/metavolcanic lithic fragments
Ls/Lsm	= sedimentary/metasedimentary lithic fragments

In the widely used simple classification (Fig. 2.50), sandstones are divided into two major groups based on texture, that is, whether the sandstones are com-posed of g rains only, t he *arenites*, or contain more than 15% matrix, f orming t he *wackes*.

For the arenites, the term *quartz arenite* is applied to those with 95% or more quartz grains, a rock type for-merly referred to as orthoquartzite (quartzite is the low-grade metamorphic equivalent). *Arkosic arenite* refers to an arenite with more than 25% feldspar, which exceeds the rock-fragments content, and *litharenite* is applied where the rock-fragment content exceeds 25% and is greater than feldspar. The arkosic arenites can be divided into *arkoses* and *lithic arkoses*. Two rock types transitional with quartz arenite are *subarkose* and *sublitharenite*. Specific names applied

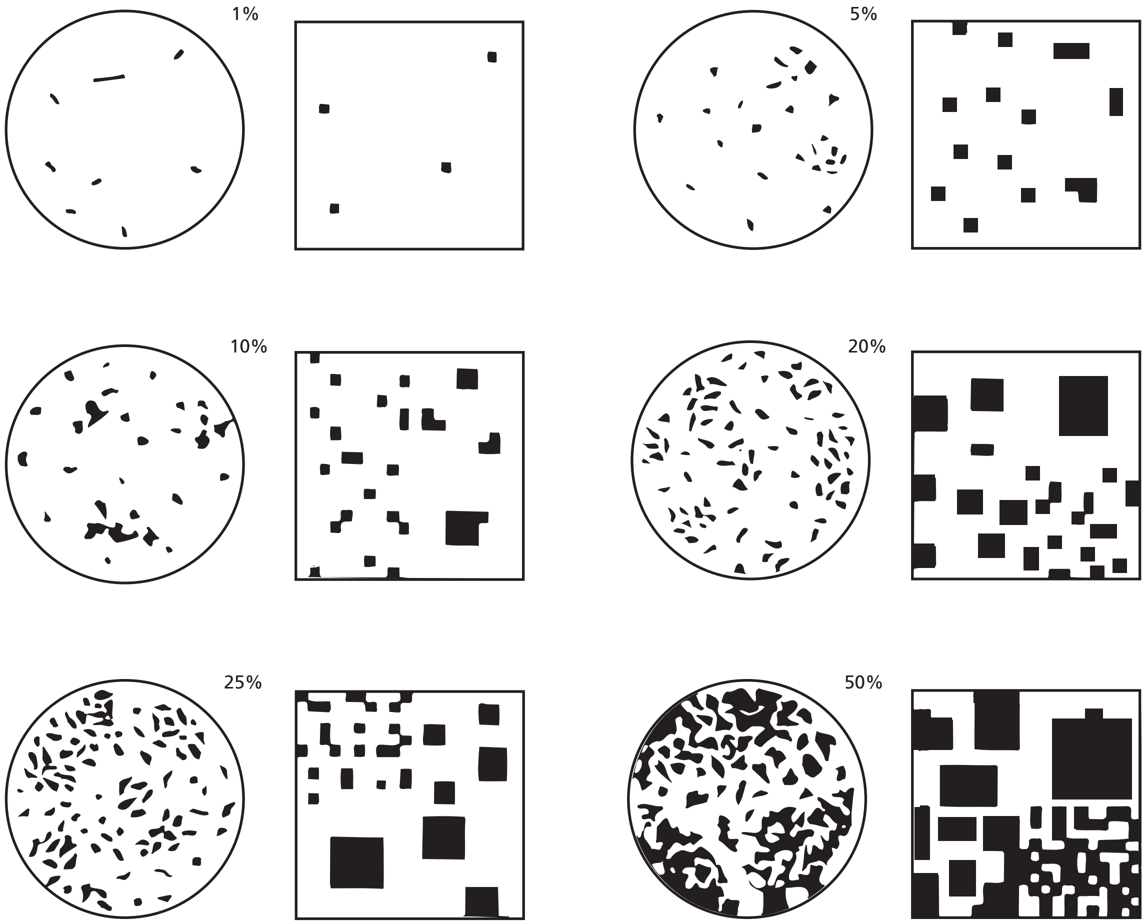

Fig. 2.49 Percentage estimation comparison charts, conventional and computer-generated. Reproduced from Terry & Chilingar (1955) and Folk *et al*. (1970) with permission of the Society of Economic Paleontologists and Mineralogists.

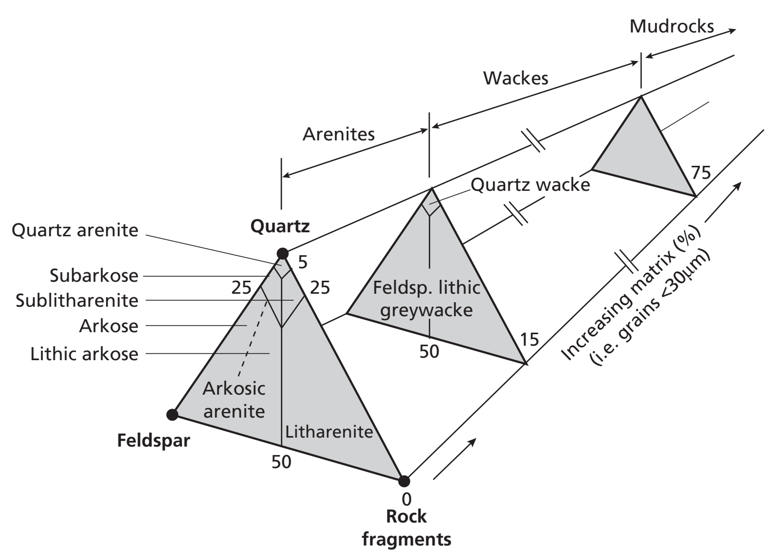

Fig. 2.50 Classification of sandstones. After Pettijohn *et al*. (1987).

to litharenites are *phyllarenite*, where the rock fragments are chiefly of shale or slate, and *calclithite*, where the rock fragments are of limestone.

The wackes are the transitional group between arenites and mudrocks. The most familiar is the *greywacke* and two types are distinguished: feldspathic and lithic greywacke. The term arkosic wacke is used for arkoses with a significant proportion of matrix. *Quartz wacke*, not a common rock type, is dominantly quartz plus some matrix.

This classification is concerned primarily with the mineralogy of the sediment and presence or absence of a matrix. It is independent of the depositional environment, although some lithologies are more common in certain environments. The nature of the cement in arenites is not taken into account. With regard to fine-grained interstitial material (matrix), a basic feature of the wackes, there is often a problem of origin. Some, perhaps most, is deposited along with the sediment grains. A part of the matrix, however, could be authigenic, a cement, and some a diagenetic alteration product of unstable grains (pseudomatrix). The latter is particularly the case with greywackes (Section 2.7.4).

In addition to siliciclastic sandstones, there are many *hybrid sandstones*. These contain a non-clastic component derived from within the basin of deposition. The three main types are calcarenaceous, glauconitic and phosphatic sandstones. In glauconitic sandstones, the glauconite occurs as sand-sized pellets (see Section 6.4.4). With phosphatic sandstones, the phosphate may be present as coprolites, faecal pellets and bone fragments (Section 7.4).

Calcarenaceous sandstones contain up to 50% $CaCO_3$ as carbonate grains. The latter are chiefly ooids, commonly with quartz nuclei, and skeletal fragments (bioclasts). Calcarenaceous sandstones occur in carbonate-producing areas where there is a large influx of terrigenous clastics. They will pass laterally into limestones or into purer sandstones towards the source of the siliciclastic sediment. Siliciclastics cemented by calcite have been referred to as calcareous sandstones. A scheme for classifying these mixed sediments has been devised by Mount (1985). For a collection of papers on these calcarenaceous sandstones see Doyle & Roberts (1988).