

# DEFINITIONS OF ARKOSE

STEVEN S. ORIEL

**ABSTRACT.** An examination of the definitions of the term *arkose* in the current literature shows that the rock is described by different writers as 1) a sandstone with a considerable amount of feldspar, 2) a coarse sandstone or fine conglomerate of quartz and feldspar, and 3) a feldspathic sandstone which looks like a granite. In defining the term in 1823, Alexandre Brongniart stressed the high feldspar content as the distinguishing feature of the rock. Thus, definition 1) most nearly agrees with Brongniart's, whereas the other two limit *arkose* to rocks which Brongniart described as varieties of arkose.

**W**HILE engaged in the preparation of a report on the geology of the Hot Springs area, Madison County, N.C.,<sup>2</sup> the writer found it necessary to reexamine definitions of the term *arkose*. In view of the revived interest in the classification of sedimentary rocks during the last few years, the results of this brief literature study are presented here.

At least three definitions of the term *arkose* are in current usage. In the definition suggested by the Committee on Sedimentation (Allen, 1936, p. 44), arkose is described as "A sandstone containing 25 or more per cent of feldspars usually derived from the disintegration of acid igneous rocks of granitoid texture."<sup>3</sup> Cordier (1868, p. 218) limits the feldspar composition to 10 to 20 per cent of the rock. Krynine (1940, p. 50) sets 30 per cent as the lower limit, but shows the "average" feldspar composition of his "arkose series" as 25 per cent in a later published figure (1948, fig. 11, p. 151). Whatever the proportion used as the lower limit, many geologists (Barton, 1916, p. 418; Coquand, 1857, pp. 236-237; Cotta, 1855, p. 214; Dana, 1863, p. 83; Grout, 1932, p. 275; Hatch, Rastall and Black, 1938, p. 84; Loewinson-Lessing, 1893, p. 18; Milner, 1940, p. 369; d'Orbigny, 1845, p. 140; Pettijohn, 1949, table 55 and fig. 66, p. 227; Shrock, 1948, p. 122; Twenhofel, 1932, p. 229; and Zirkel, 1866, vol. II, p. 526) have accepted the definition of an arkose as a sandstone containing a substantial amount of feldspar and derived from granitic rocks.

<sup>1</sup> The writer is grateful to Messrs. Adolph Knopf, John Rodgers, and Gerald V. Carroll for helpful suggestions.

<sup>2</sup> To be published as a bulletin of the North Carolina Department of Conservation and Development.

<sup>3</sup> Sandstone is defined as a consolidated rock composed of cemented sand grains between 1/16 mm. and 2 mm. in diameter (Allen, 1936, p. 46).

Cayeux (1929) defines arkoses as "very coarse feldspathic or kaolinitic sandstones derived from granitic or gneissic sand" (translated from p. 207). "Arkoses form a transition, by mineral size, between the finer components of pudding-stone [lower limit: 5 mm., pp. 9, 119-120] and sandstone, properly speaking ["5 mm. to 0.5 mm.," p. 124], but with a greater affinity to sandstone than to pudding-stone" (p. 214). Thus the distinction made by Cayeux between feldspathic sandstone and arkose is one of size, not of total feldspar content. Bertrand (1928, p. 448), Dana (1894, p. 82), and Holmes (1920, pp. 36, 282) also limit *arkose* to rocks intermediate in grain-size between psammites and psephites. This definition is supported by that of Omalius d'Halloy (1831, p. 537) which states, in translation, that an arkose is a "conglomeratic rock composed of quartz and feldspar."

De Lapparent (1906) considers arkoses as "rocks formed principally of quartz and feldspar, perhaps with mica, in a manner simulating a true granite, whence the name *decomposed* or *regenerated granite* is given to them" (translated from p. 685). Thus, in addition to requiring that the rock contain a considerable amount of feldspar, de Lapparent and others (Krynine, 1940, p. 50; Murchison, 1867, p. 347; Pirsson and Knopf, 1947, p. 251; and Rosenbusch, 1898, p. 393) impose or suggest the second condition that arkose simulate a granite in appearance.

In view of this divergence in the current definitions of *arkose*, the present writer turned to the original definition of the term by Alexandre Brongniart (1823, pp. 497-498). The term was introduced by Brongniart in an attempt to limit the use of the word sandstone (*grés*), which he felt included too many diverse rocks. He retained the word sandstone for those rocks consisting almost entirely of granular quartz (as distinguished from glassy quartz in quartzites). His definition of the term, literally translated, is, "Arkoses are composed of large grains of glassy quartz and of feldspar, mixed together unequally and including as fortuitous constituents mica, clay, often kaolin, etc."

Why Brongniart chose the word *arkose* is not known. Insofar as the present writer has been able to determine, the word did not exist before 1823. In his original definition of the term, Brongniart (1823, p. 498) does not indicate the derivation of

the term but does say that it is one of the names he has adopted at the suggestion of Omalius d'Halloy. The derivation of the term is not indicated in those publications by Brongniart, Omalius d'Halloy, and other writers available to the writer.

The present writer tentatively suggests that the term *arkose* was taken from the Greek *archaios* meaning ancient or primitive. The points which bear on this view are as follows:

1) Brongniart states (1826, p. 30) that rock names should be derived, with few exceptions, from the "sonorous" Latin and Greek languages and should be easily pronounced by all peoples.

2) Brongniart states (1826, pp. 123-124) that the majority of arkoses studied by him rest directly on granite and indicate ". . . a quite ancient epoch of formation." However, elsewhere in the same paper, Brongniart concludes that there are younger arkoses and age is not implicit in the definition of the term.

3) Brongniart wrote his papers with clarity and in detail. This suggests that he omitted the derivation of the term as superfluous, in view of its similarity to the Greek *archaios*.

4) The use of *k*, rather than *ch* or *c*, in spelling the word is rather curious. Brongniart may have used *k* in preference to the others to insure that the term would be pronounced similarly in French, German, and English, or he may simply have followed the example of Jurine (1806, pp. 373-374), who had previously proposed another rock name, *arkesine*,<sup>4</sup> from the same Greek root.

Brongniart discussed the arkoses more fully in a 51-page paper in 1826. Inasmuch as no statement of his views appears in the modern literature (probably because his publications are not easily available) and as it has a bearing on the present problem, excerpts from his petrographic discussion are translated below. (His views on genesis of the rock, though interesting, do not bear on the problem here.)

Arkose is a rock of grainy texture formed principally as a result of mechanical aggregation.

It is *composed essentially* of large grains of glassy quartz and grains of lamellar, compact or clayey feldspar: these two minerals are often mixed in more or less equal quantities but more often quartz is dominant. It includes, as *accessory constituents*, mica,

<sup>4</sup> Proposed for the talc- and chlorite-bearing hornblende granite on Mont Blanc, the term is no longer in use.

lithomarge clay, and kaolin, in quantities less than either quartz or feldspar.

The *fortuitous ingredients* (*parties accidentales*) which are disseminated through the arkose are many [and a list of those minerals which he identified is presented].

This rock has no distinct small scale structure, and rarely even on a large scale, and it is generally thick-bedded.

Its texture is essentially grainy; grains angular, ranging from millet-seed size to pea size. The mass of the rock was evidently formed as a result of mechanical aggregation; the irregular and angular form of the grains and especially their "limitation," such that they do not penetrate one another, is the proof of it . . .

The arkoses, sometimes so distinctly characteristic that one cannot confuse them with any other rock, in some cases present vague, uncertain, or incomplete characteristics.

When the feldspar content is low and the quartz content high, the rock passes into quartzite, if the quartz is glassy, or into sandstone (*grés*) if the quartz is finely granular . . .

The varieties which are present in these rocks are not numerous and may be reduced to the following:

#### *Common arkose*

Composed of glassy quartz and grains of feldspar with very little mica; quartz dominant. Color grayish or whitish . . .

#### *Granitoid arkose*

Grains of quartz, of lamellar feldspar and of mica, more or less disposed as in granite; feldspar dominant.

This rock does not differ from granite except that it is evidently formed by aggregation.

#### *Miliary arkose*

Grains of quartz and feldspar, as large as millet seeds at the most; disseminated colored clay; quartz dominant; little mica . . . does not differ from common and granitoid arkose except by grain size . . .

It is evident from the excerpts quoted here that Brongniart considered the granitic appearing rocks as one of several forms of arkose. Therefore it appears that the second condition imposed by the de Lapparent definition, i.e. that the rock simulate a granite in appearance, was not considered necessary by Brongniart. Furthermore, the subjectivity of the condition makes it undesirable in modern usage.

Although Brongniart specified "large grains" in his original definition, it is the present writer's belief that it is not an essential part of his definition. This view is supported first by

his making arkose a subdivision of sandstone (1827, p. 43) and second by his defining fine-grained or miliary arkose as one of the varieties of arkose. Therefore, and because the size connotations stressed by Cayeux have not been generally adopted in most countries, it seems unlikely that Cayeux's definition will prove acceptable to most geologists, despite the support it receives from that of Omalius d'Halloy.

Thus, of the three definitions of arkose in current usage, that of the Committee on Sedimentation appears to reflect the meaning intended by Brongniart best and does so in quantitative terms and in conformity with the usage of many geologists. The other two definitions may well be retained for varieties of arkose, in keeping with the procedure of Brongniart himself.

#### REFERENCES

- Allen, V. T., 1936. Terminology of medium-grained sediments (with notes by P. G. H. Boswell): Nat. Research Council Ann. Rept. 1935-1936. App. I, Rept. of Comm. on Sedimentation, pp 18-47.
- Barton, D. C., 1916. The geological significance and genetic classification of arkose deposits: Jour. Geology, vol. 24, pp. 417-449.
- Bertrand, L., 1928. La science des roches, 3rd Fr. Ed., by F. Rinne, Paris, 615 pp.
- Brongniart, A., 1823. Macigno: Dict. des sci. nat., vol. 27, pp. 497-504.
- , 1826. De l'Arkose, caractères minéralogiques et histoire géognostique de cette roche: Annales des sci. nat., vol. 8, pp. 113-163.
- , 1827. Classification et caractères minéralogiques des roches homogènes et hétérogènes, Paris, 144 pp.
- Cayeux, L., 1929. Les roches sédimentaires de France: Roches siliceuses: Mém., Carte Géol. Détaillée de la France, Paris, 774 pp.
- Coquand, H., 1857. Traité de roches, Paris, 423 pp.
- Cordier, P. L. A., 1868. Description des roches composant l'écorce terrestre, Ed. by C. d'Orbigny, Paris, 553 pp.
- Cotta, B., 1855. Die Gesteinslehre, Freiberg, 256 pp.
- Dana, J. D., 1863. Manual of geology, 1st Ed., Phila., 798 pp.
- , 1894. Manual of geology, 4th Ed., New York, 1087 pp.
- Grout, F. F., 1932. Petrography and petrology, New York, 522 pp.
- Hatch, F. H., Rastall, R. H., and Black, M., 1938. The petrology of the sedimentary rocks, 3d Ed., London, 383 pp.
- Holmes, A., 1920. The nomenclature of petrology, London, 284 pp.
- Jurine, L., 1806. Sur les roches colligées dans les Alpes. Jour. des mines, vol. 19, pp. 367-378.
- Krynine, P. D., 1940. Petrology and genesis of the Third Bradford Sand.: Penn. State College Min. Ind. Exp. Sta. Bull., vol. 29, p. 134.
- , 1948. The megascopic study and field classification of sedimentary rocks: Jour. Geology, vol. 56, pp. 130-165.
- De Lapparent, A., 1906. Traité de Géologie, 5e éd., Paris.
- Loewinson-Lessing, F., 1893. Petrographisches Lexikon, Jurjew, 255 pp.
- Milner, H. B., 1940. Sedimentary petrography, 3d Ed., London, 666 pp.

- Murchison, R. I., 1867. *Siluria*, 4th Ed., London, 556 pp.
- Omalius d'Halloy, J. J., 1931. *Eléments de géologie*, Paris, 558 pp.
- D'Orbigny, C., 1845. *Arkose*: *Dict. universal d'Histoire nat.*, vol. 2, pp. 140-141.
- Pettijohn, F. J., 1949. *Sedimentary rocks*, New York, 526 pp.
- Pirsson, L. V., and Knopf, A., 1947. *Rocks and rock minerals*, 3d Ed., New York, 349 pp.
- Rosenbusch, H., 1898. *Elemente der Gesteinslehre*, 1st Ed., Stuttgart.
- Shrock, R. R., 1948. A classification of sedimentary rocks: *Jour. Geology*, vol. 56, pp. 118-129.
- Twenhofel, W. H., 1932. *Treatise on sedimentation*, Baltimore, 926 pp.
- Zirkel, F., 1866. *Lehrbuch der Petrographie*, 1st Ed., vol. 2, Leipzig.

GEOLOGY DEPARTMENT  
YALE UNIVERSITY, NEW HAVEN, CONN.