the mixing zone. Determinations are made under conditions of minimum stream flows and maximum water temperatures.

No waste may be discharged to a stream in Tennessee without a permit. Pertinent data concerning the proposed discharge, together with preliminary plans for waste treatment facilities, are submitted to the Tennessee Department of Public Health. No construction may be started until approval has been obtained. All permits are revocable and subject to modification as indicated by operating records, investigations, or conditions in the receiving stream.

All of the mills discussed in this paper have complied with state regulations concerning anti-water pollution, and four mills have anti-air pollution.

Forest Management. One of the outstanding conservation features of two paper companies, Bowaters Southern Paper Corporation and Tennessee River Pulp and Paper Company, is the program of forest management. For example, the Wood and Land Division of Tennessee River Pulp and Paper Company is working with nature to improve the quality and growth of the forest. Through a progressive program of forest management, company foresters are working to grow crops of trees over and over again on the same tree farm land.

Tree planting, pine stand maintenance, forest fire prevention and control, and research and development of better forests are among the scientific forestry practices applied to company-owned woodlands. Equally important in the forestry program is assistance to land owner and pulpwood producers. Conservation foresters are trained to provide free technical services and demonstrations to encourage the wise use of forest resources.

Another example of sound forest management is the "multiple use" concept in practice by Bowaters. Their forest lands are open to the public for such recreation as hunting, fishing, hiking, camping, and other recreational activities.

A New Raw Material. Pulp and paper mills, in cooperation with local and state agencies, are engaged in reforesting to have a continuous supply of young pulpwood. However, as the demand for paper increases and more mills develop, it may become almost impossible to supply the needed pulpwood from local sources. The answer may rest with a promising substitute called Kenaf. Conclusive tests are not yet available, but it is believed that the pulping properties of Kenaf will equal those of softwoods and will be superior to hardwoods.

The Future of Pulp and Paper in Tennessee

Pulpwood demands by the year 2000, a time when the population of the United States is expected to reach 328 million, is anticipated to be three times that of today, in view of the growing needs for newsprint, towels, clothing, food containers and other disposables. Industry and various governmental agencies have indicated that the South will probably provide most of the additional timber growth to meet the increased demand.

Along with softwood, Tennessee grows a large amount of hardwood timber on its 14 million acres of forest land. Much of this hardwood is suitable for pulping and the growth exceeds harvest by substantial amounts. Also, better markets for the lower grade hardwoods would accelerate their harvest and thus improve the capacity of forest stands to grow more and better pulpwood.

Training of manpower for forest industry employment is rapidly expanding. Many technical, vocational and high schools offer forest industry-related courses. By the year 2000, it is estimated that an additional 50,000 trained workers will be required.

Tennessee now ranks third in the Southeast as a manufacturing center. However, development of the additional hardwood pulping capacity would create the needed market, and at the same time, increase employment and improve the general economic climate.

The next growth phase of the pulp and paper industry in the state will probably involve greater hardwood utilization. Due to many factors, some of which have been discussed in this paper, an extensive hardwood pulping base could be adequately supported in the state.

JOURNAL OF THE TENNESSEE ACADEMY OF SCIENCE

Volume 46, Number 3, July, 1971

PETROGRAPHY OF A BASEMENT GRANITE FROM CENTRAL TENNESSEE

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ABSTRACT

Recent drilling in Davidson County penetrated basement. No description of basement rock in Central Tennessee has previously been published. The rock encountered is a massive, medium-grained pink granite consisting mainly of albite, perthitic microcline, quartz, and biotite. Accessories include magnetite, apatite, rutile, zircon, and epidote. Although alteration is not excessive, it is pervasive. Alteration species are chlorite, hematite, clay, sericite, calcite, and possibly some magnetite.

In 1969 a diamond drill hole penetrated the basement in Davidson County near Nashville, Tennessee.* Gran-

* Dupont No. 1 Monitoring Well (Old Hickory). Carter Coordinate location SW NW Sec. 16, 3S-35E.

itic rocks were encountered at a drilling depth of 5460 feet. Because no description of the basement in Central Tennessee has previously been published, a petrographic study of the core was undertaken by the writer. Samples were provided by S. W. Maher of the Tennessee Division of Geology.

The core sample studied is a medium-grained pink granite. Grains generally range from about 2-5 mm in diameter. The texture is noticeably massive. Potash feldspar, quartz, zoned plagioclase and a dark micaceous mineral are visible to the naked eye. Except for some clustering of the mafics, the mineral distribution is random. Only minor alteration effects can be seen in hand specimen.

Thin section study shows that the granite is holocrystalline granular with no obvious grain orientation. Although a few large microcline grains occur, they are not abundant enough to give the rock a porphyritic character. Quartz, potash feldspar, and plagioclase are the major constituents and they account for over 90 percent of the rock. Biotite (including secondary chlorite) and magnetite occur in minor amounts. In addition, traces of accessory apatite, zircon, rutile, and epidote are randomly distributed. Secondary species are chlorite, hematite, clay, sericite, and calcite. Modal analyses of two specimens are given below:

	69-20	69-21
Potash feldspar (perthitic microcline)	29%	35%
Albite (Ab_{92})	26	21
Quartz	40	39
Biotite (including chlorite)	4	4
Magnetite	1	1
Accessories	tr	tr
	100%	100%

The chemical composition calculated from the average of these two modes is as follows:

SiO_2	76.3%
Al_2O_3	11.7
Fe_2O_3	1.5
FeO	0.8
MgO	1.3
CaO	0.4
Na_2O	2.9
K_2O	5.2
H_2O	0.1
	100.2%

Quartz is the most abundant mineral, typically occurring as randomly distributed anhedra. Although most grains range from 2-3 mm in diameter, a few reach 5 mm and many are less than 1 mm in size. These smaller grains are particularly noticeable as blebs in microline. Granulation is absent; however, many grains show minor fracturing and some undulatory extinction. Some quartz is myrmekitic.

The rock contains both potash and plagioclase feldspars. Potash feldspar is anhedral to subhedral perthitic microline. The exsolved albite in some grains nearly obscures the characteristic microline twinning. Grains are typically 3-5 mm in diameter, although some are as large as 7 or 8 mm. Abundant inclusions of apatite, tiny quartz blebs, and small plagioclase laths give some microline a poikilitic appearance. Clayey and sericitic alteration is common along twin planes. The second feldspar is albite (Ab_{92}). Most grains are subhedral and range from 1-3 mm in diameter. The plagioclase included in microcline, however, is less than 0.5 mm in size. The typical albite twinning is prominent and because of this polysynthetic twinning micro-faulting can be recognized in some grains. Zoned plagioclase subhedra are not uncommon. Clay and hematite typically coat twin planes and follow zonal growth lines.

Brown biotite is the most abundant minor mineral. It occurs as laths (up to 1-2 mm long) and as blocky grains, both types typically in randomly distributed clusters with no apparent orientation. Chloritization is common. Some biotite grains are completely chloritized, whereas others show only incipient chloritization. The chlorite is probably pennine. A small (typically less than 0.5 mm in diameter) opaque mineral is present in amounts approximating 1 percent. It is probably magnetite. Much is undoubtedly primary; however, some may be derived from the alteration of biotite. The remaining primary minerals occur as randomly distributed trace constituents except for zircon which occurs in biotite. Pleochroic halos on zircon are common.

Alteration, although not excessive, is pervasive. Nearly all biotite shows some alteration, the products being chlorite and perhaps some magnetite. Potash feldspars are sericitized and also show clayey alteration. Plagioclase is typically coated with a dusty layer of hermatite and clay, both of which are concentrated along twin planes and growth zones. It is this hematitic dust which apparently gives albite the distinct pink color visible in hand specimen. The origin of the minor epidote is obscure; it may be related to plagioclase alteration. Minor calcite veinlets cut some feldspar grains. The origin of the calcite, likewise, is obscure. Too few specimens were studied to allow any discussion on genesis of the alteration. The suite of secondary minerals, however, suggests hydrothermal rather than purely deuteric effects.