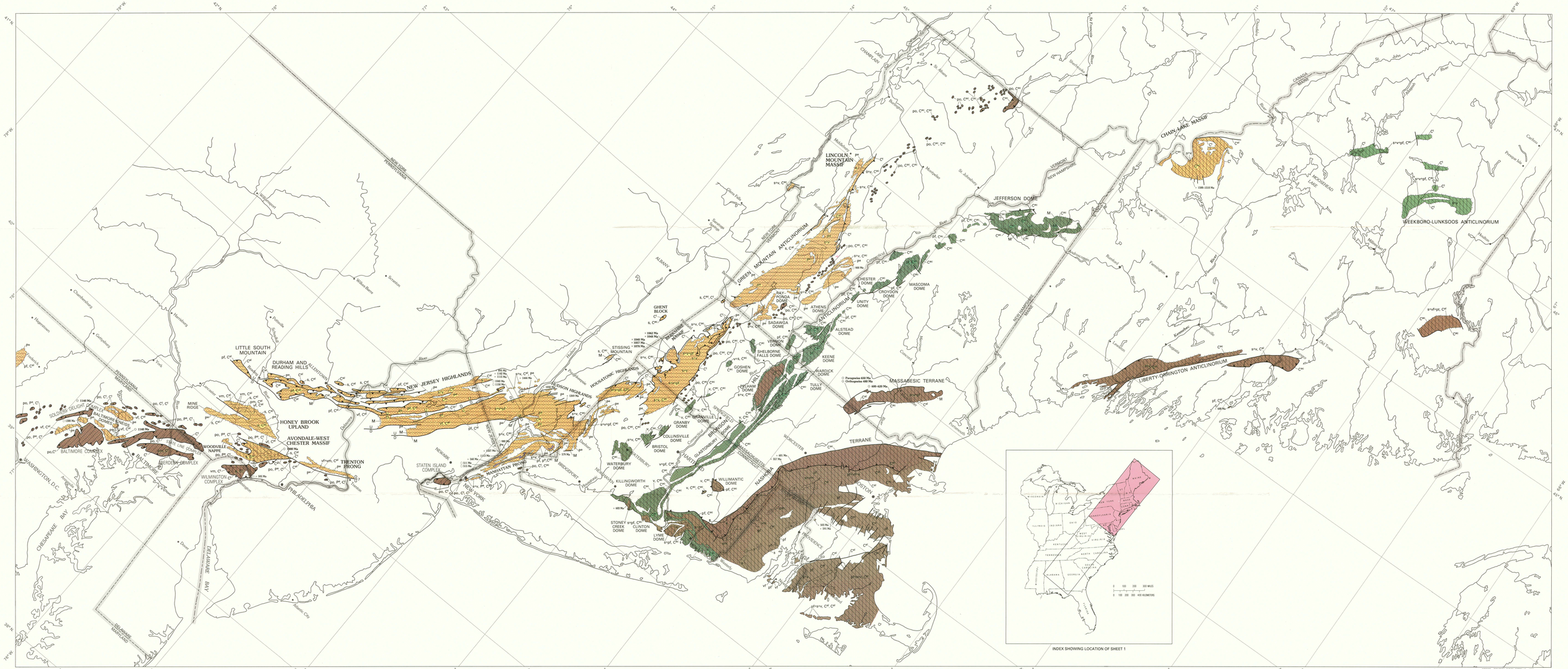

SCALE 1:1 000 000

25 0 25 50 75 100 MILES

25 0 25 50 75 100 KILOMETERS

Compilation finalized in January, 1984

This map is one of the topical products of the United States Working Group of the International Geologic Correlations Program's Project 27, the Appalachian-Caledonian-Hercynian-Mauritinide orogen. It depicts the distribution of basement rocks within the United States part of the Appalachian orogen. The term "basement" is generally applied to rocks that belong to a previous orogenic cycle and that have been incorporated into a younger cycle of mountain building. On this map, we have considered as basement those rocks that were formed, intruded, metamorphosed, or structurally consolidated prior to the deposition of sedimentary or volcanic cover sequences deformed during the Taconian, Acadian, and Alleghanian orogenies. In addition, the relation of basement to the cover sequences is shown.

Rocks that we consider to be basement fall into three age groups: Grenvillian (900–1600 Ma), Avalonian (570–900 Ma), and post-Proterozoic–pre-Middle Ordovician (491–570 Ma). In assigning rocks to these groups, we have relied on published Rb-Sr and U-Pb-Th zircon ages. These ages have not been recalculated using constants recommended by Steiger and Jaeger (1977), nor have we made a systematic evaluation of the reliability of the reported ages in areas of high-temperature metamorphic overprinting.

Basement rocks of Grenvillian age occur as both external and internal massifs in relation to the Appalachian metamorphic core as well as in massifs that probably represent either rifted fragments of North American crust or totally exotic terranes. The external massifs extend from the Corbin-Salem Church Complex on the south to the Green Mountain anticlinorium on the north. The rocks of these massifs are unconformably overlain by cover rocks of Late Proterozoic and (or) Early Cambrian age. These massifs are either parautochthonous or allochthonous, although in some cases (such as in the Blue Ridge-South Mountain anticlinorium, parts of the New Jersey and Hudson Highlands, and the Green Mountain anticlinorium) the bounding thrust fault is either blind or crops out within the cover sequence.

The internal massifs consist of the Grenville rocks of the Pine Mountain window on the south, the Tallulah Falls and Toxaway domes, the Grenvillian rocks of the Sauratown Mountains anticlinorium, and the domes on the east limb of the Green Mountain anticlinorium.

Rocks of the State Farm terrane and the Chain Lakes Complex occur within the internal zone that may represent either rifted fragments of North American crust or completely exotic terranes. The Chain Lakes Complex appears to be completely foreign, whereas rocks of the State Farm terrane are similar to some of those in the Blue Ridge, although typical North American cover rocks have not been recognized. Some geologists (Farrar and others, 1983) suggest that a more extensive area of basement rocks, the Goochland terrane, occurs superjacent to the State Farm terrane. It is impossible at this time to evaluate this suggestion, or to define the boundaries of the proposed Goochland terrane, so it is not shown on this map. Also within the internal zone are the Baltimore gneiss domes and the Avondale-West Chester massif. These rocks clearly are in the age range of the North American Grenville rocks. They are, however, quite different from the Blue Ridge or adjacent Honey Brook Upland and we believe that they may represent rifted fragments of North America.

Rocks of 570–900 Ma age are abundant in coastal southern New England, in the Massabesic terrane, in the core of the Liberty-Orrington anticlinorium in southeastern Maine, and the core of the Pelham dome within the Appalachian metamorphic core. For some time, these rocks have been recognized as part of an exotic Avalonian terrane and as a younger basement in New England.

Highly allochthonous ultramafic and related mafic rocks are shown on the map to insure international consistency with other Project 27 products as we believe that at least most of these rocks are ophiolites or ophiolite fragments. From Pennsylvania southward, these rocks are either thrust on or occur as olistoliths in Late Proterozoic and earliest Cambrian rocks. In New England, they are tectonically mixed with Cambrian and Lower Ordovician rocks. For these reasons, we believe them to be largely of Late Proterozoic age. One other massif, the Wilmington Complex, is thought to be of Late Proterozoic age as it is intruded by a Cambrian pluton. Rocks of the Wilmington Complex are unlike any other rock in the central Appalachians. Brown and Van der Voo (1983) suggest on the basis of a paleomagnetic study that this part of the central Appalachian Piedmont was part of the African plate and was sutured to North America when the Iapetus Ocean closed. For these reasons, we consider the Wilmington Complex to be an exotic terrane.

We consider the rocks described above as basement. Somewhat more controversial, perhaps, is our depiction of rocks that lie between rocks of Late Proterozoic age and those of Middle Ordovician, Silurian, or Devonian age in the domes along the Bronson Hill anticlinorium, in the core of the Weekeboro-Lunksoos anticlinorium, and other places in north-central Maine as basement. These rocks form the substrate upon which younger rocks that were involved in the Acadian and Alleghanian orogenies were deposited. In this way, they fit our definition of basement. In addition, some, but certainly not all, of these rocks can be proved to have been crystalline prior to deposition of their cover. We therefore prefer to consider these rocks as part of the basement in the Appalachian orogen in the United States.

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EXPLANATION

AGE OF BASEMENT ROCK INCLUDING OPHIOLITE COMPLEXES AND FRAGMENTS

- Pre-Middle Ordovician—491–570 Ma
- Avalonian—570–900 Ma
- Grenvillian—900–1600 Ma

TECTONIC STATUS

- Allochthonous or parautochthonous (in the Alpine sense, Heritsch, 1929) basement; that is, the rock body has known autochthonous equivalents. Rock body is not necessarily bounded by a thrust fault at the surface, but may be above a thrust fault that crops out within the cover rocks or is blind such as in the northern Blue Ridge, parts of the Reading Prong, and the Green Mountains.
- Highly allochthonous basement; that is, the rock body has no known autochthonous equivalent
- Basement terrane that is either rifted fragment of, or exotic to, the North American craton. These rocks may also be allochthonous to their cover

DATE OF LAST MAJOR TECTONISM

- M (Mesozoic)—Post–230 Ma
- C^{al} (Alleghanian)—230–280 Ma
- C^{ac} (Acadian)—360–400 Ma
- C^{t} (Taconian)—450–470 Ma
- p^{p} (Late Proterozoic)—570–750 Ma

NATURE OF BASEMENT-COVER CONTACT

(Age of contact is specified by a tectonism symbol, such as C^{al})

- Intrusive contact
- Unconformity
- Thrust fault
- High-angle fault—U, upthrown side; D, downthrown side

METAMORPHIC STATE PRIOR TO DEPOSITION OF COVER

- High-grade (hornblende-amphibolite facies and above)
- Medium-grade (epidote-amphibolite facies)
- Low-grade (greenschist facies)

RADIOMETRIC AGE

- • 1057 Ma Rb/Sr
- ○ 1140 Ma Zircon

PRIMARY ROCK TYPE

- s Metasedimentary
- vm Metavolcanic, mafic
- vf Metavolcanic, felsic
- v Metavolcanic, undifferentiated
- pf (Meta) plutonic, felsic or intermediate
- pm (Meta) plutonic, mafic or ultramafic
- po Ophiolitic complexes and fragments

Note: For convenience, ophiolite fragments are depicted as being thrust-bounded although some may be large olistoliths. For small rock bodies, symbols are given in the sequence: primary rock type, age of contact, and date of last major tectonism, such as pf+s, C^{t}, C^{al}.

BASEMENT AND BASEMENT-COVER RELATION MAP OF THE APPALACHIAN OROGEN IN THE UNITED STATES

By

Avery Ala Drake, Jr., Leo M. Hall, and Arthur E. Nelson

1988

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