

## *k21* Proterozoic anorthosites <massif-type, anatectic, emplaced 1.1-1.5 Ga>

The meaning of which nobody knows,  
Or whose meaning is that nobody knows.

—Gjertrud Schnackenberg, *The Throne of Labdacus*.<sup>1</sup>

Anorthosites are basic, plutonic, igneous anorthosite (Ca-plagioclase) rocks. While monomineralic as to that essential igneous rock mineral, accessory ilmenite (FeTiO<sub>3</sub>) often makes them a titanium ore.

Enlivening the Middle Proterozoic (0.9-1.6 Ga), which some have dubbed “the dullest time in Earth’s history” (as the carbon-isotope ratio stayed unchanged in the interval 1.0-2.0 Ga),<sup>2</sup> is a chemically distinctive variety of anorthosites (An<sub>40-60</sub>) called *massif anorthosites*. These were emplaced 1.1 Ga in the Grenville mobile belt, and 1.4-1.5 Ga in older rocks of Labrador (**Figure k21.1**) and elsewhere in the world. “Massif” simply means a block of rock undeformed in an orogenic- or, if ancient, a mobile-belt. However, it is the chemistry of the massif anorthosites that makes them recognizable even where, as in the Appalachian mobile belt, they were folded later. Why all have Mesoproterozoic ages could find explanation in worldwide shutdown for the while of subduction.<sup>3</sup>

In Labrador, where the country rocks are of very low metamorphic grade (greenschist), massif anorthosites are surrounded by contact aureoles with low-pressure metamorphic minerals.<sup>4</sup> Such emplacement at shallow depth in the continental crust is everywhere typical of these igneous bodies. In them, the last emplacements are of Ti-Fe rich heavy liquids left out of crystallizing plagioclase in the feeding magma chamber. Deducible from the chemistry of the massif anorthosites is that they were magmas that originated by anatexis (secondary melting) of igneous (not sedimentary) rocks of alkali basalt (tholeiite) composition in the continental crust. In the source magma chambers prolonged crystallization of plagioclase and its concentration occurred to produce the massif-anorthosites magma differentiate. □

**Figure k21.1**<sup>5</sup> Distribution of massif-anorthosite outcrops (black) in the Grenville Province and north of the Grenville Front in Labrador, with mined, or prospects for, titanium ore.

Titanium metal is light in weight, strong, and non-corrosive, and is used in aircraft, marine, and spacecraft equipment, and, being hypoallergenic, in surgical implants (which, as it is non-magnetic, will not trigger most security metal detectors).

Powdered titanium dioxide is stark white and is used as a pigment in plastics, rubber, paper, and in nontoxic white paint (as a replacement for toxic lead-oxide used in Cremnitz white or Flake white—the oldest of the artist’s white paint, believed to have been discovered by the ancient Egyptians.)

