The North Fork stock is a composite intrusive body of Late Jurassic-Early Cretaceous age which outcrops in the Blue Mountains of northeastern Oregon. The upper 600 m of the intrusion are exposed over an area of approximately 36 km² along the canyon walls of the North Fork of the John Day River in Grant and Umatilla counties. The stock intrudes metasediments, metavolcanics, and metagabbros associated with the Permian-Triassic Elkhorn Ridge Argillite. Contact metamorphism of the Elkhorn Ridge Argillite is developed to the hornblende-hornfels facies throughout most of the exposed
area of this unit in the study area. The contact aureole of the North Fork stock extends away from the intrusive margins and ultimately grades into regionally metamorphosed green-schist- and amphibolite facies rocks. The metamorphic rocks exhibit a pronounced regional trend of foliation which is disrupted where it intersects intrusive contacts at steep angles.

The North Fork stock comprises at least 21 mineralogically, texturally, or geochemically distinct units which range in composition from gabbro to quartz-rich granitoid. The earliest intrusive phase is represented by hornblende gabbro, which occurs as xenoliths within younger quartz diorite. The bulk of the intrusion is represented by the concentrically zoned North Fork tonalite-granodiorite, which ranges in composition from biotite-hornblende tonalite to biotite-hornblende quartz diorite to hornblende-bearing, biotite granodiorite. Three minerallogically equivalent granodiorite bodies exist. Late-stage granitic dikes and minor stocks cut the tonalite-granodiorite, as do lamprophyre, quartz diorite, granodiorite, mafic, and basalt dikes. A concentrically zoned lamprophyre body comprising lamprophyre, orbicular lamprophyric tonalite, and hornblende tonalite pegmatite is spatially associated with the North Fork intrusion. The North Fork stock and its surrounding country rocks are unconformably overlain by younger rocks of the Clarno Formation and the Columbia River Basalt Group.

Xenoliths derived from wallrocks and from earlier in-
trusives are common in the tonalite-granodiorite rocks which suggests stoping to be the dominant emplacement mechanism at the present level of exposure. Evidence for forceful emplacement also exists thus implying that the stock was at least partially emplaced by this mechanism. Field, petrographic, and geochemical evidence support the interpretation that the North Fork stock is a post-tectonically emplaced, imperfectly exposed, stock-shaped mass which extends to the south of present exposures beneath a thin cover of metamorphic rocks.

Geochemical analyses of selected samples indicate that rocks of the stock may be characterized by their respective concentrations of Fe, Na, and K, and also by their REE profiles. Concentrations of Co, Sc, and Cr may also be used to distinguish different units of the stock. Observed geochemical trends in the North Fork stock indicate that the composite nature of the stock is a result of both multiple magmatic injections and of magmatic differentiation due to fractional crystallization. The hornblende gabbro is the most primitive rock and is characterized by slightly LREE enriched, subchondritic REE profiles at ~20 X chondrite. Progressing inward from the main intrusive margin, the REE are progressively enriched, with subsequent development of a negative Eu anomaly and distinct LREE enrichment. Accompanying these changes are decreasing concentrations of the transition metals (Fe, Sc, Co, and Cr) and generally increasing concentrations of the LIL elements. Such trends are generally compatible with
crystal fractionation models. Observed variations in the tonalite-granodiorite series may theoretically be explained by equilibrium fractionation of a hornblende-plagioclase assemblage while minor crossovers in REE profiles may be in part due to minor fractionation of accessory minerals. Geochemical considerations preclude derivation of the tonalite-granodiorite by fractionation of the more primitive hornblende gabbro magma.