SILURO-DEVONIAN PLUTONIC AND ASSOCIATED VOLCANIC ROCKS OF THE COASTAL MAINE MAGMATIC PROVINCE

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Introduction

The plutonic and volcanic rocks that we studied occur along the coast of Maine between Bar Harbor and Jonesport. They are included within the Coastal Maine Magmatic Province (CMMP) (Hogan and Sinha, 1989), a province that contains more than 100 mafic and felsic plutons apparently emplaced over a time span from the Late Silurian to the Early Carboniferous. The bimodal character of this province is well established in both plutonic and volcanic rocks (Chapman, 1962; Seaman et al., in press), and there is widespread evidence for commingling between mafic and felsic magmas (Stewart et al, 1988; Chapman and Rhodes, 1992). Gravity studies (Hodge et al., 1982) indicate that many of the granitic plutons are thin, with gently-dipping floors, and probably rest on mafic rocks similar to the interlayered diorite and gabbro that partly surround and dip beneath several of them. The plutons of the CMMP intrude a variety of metasedimentary and metavolcanic rocks in several fault-bounded, northeast-trending terranes featuring different stratigraphies and different structural and metamorphic histories (Williams and Hatcher, 1982). The ages and field relations of many of these plutons suggest that they postdate the main assembly of these lithotectonic terranes (Ludman, 1986). Hogan and Sinha (1989) suggested that some of the magmatism was related to rifting in a region of transtension along a transcurrent fault system.

Field relations

This area of the Maine coast is dominated by the Gouldsboro granite and the Pleasant Bay layered mafic-silicic intrusion (Wiebe, 1993) (Fig. 1). These rocks are intruded mainly into Paleozoic metavolcanic rocks which

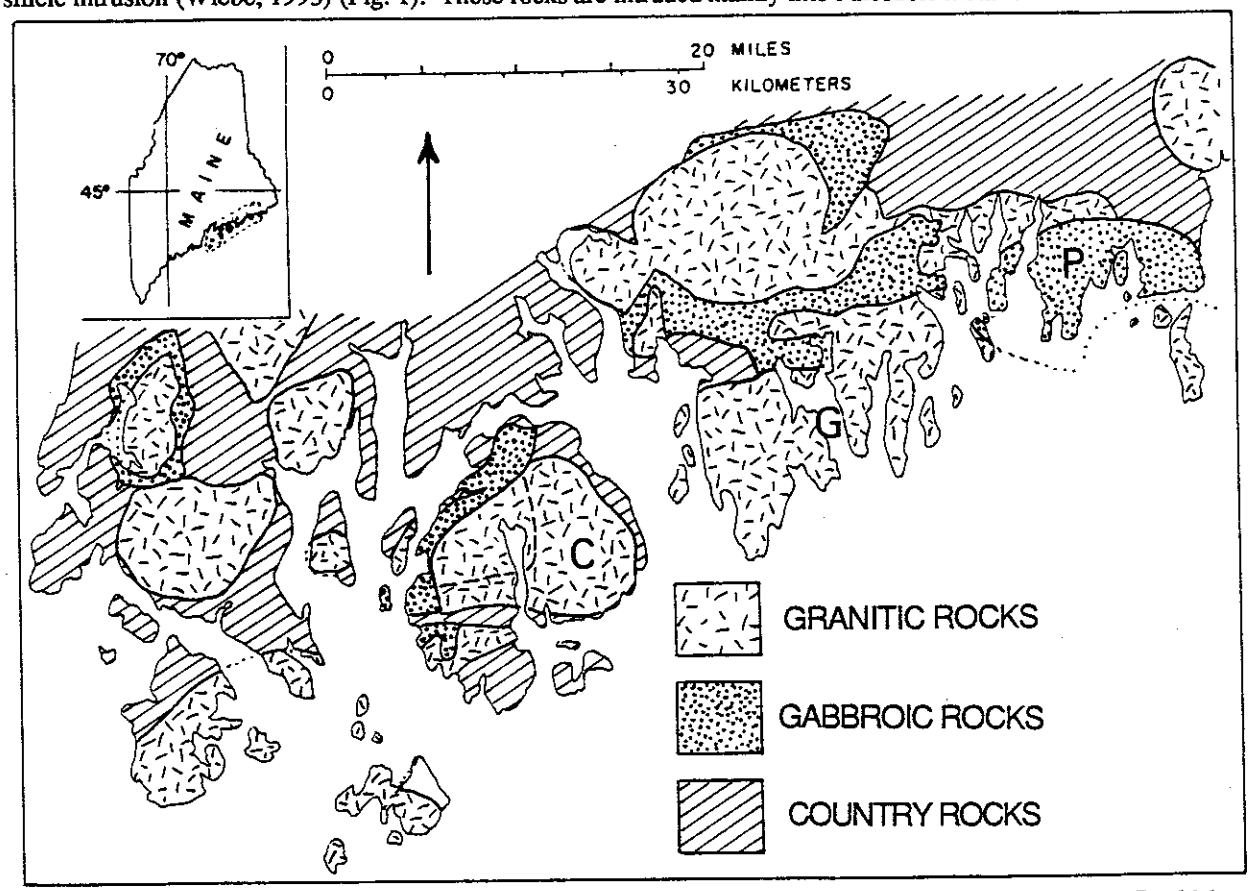

Figure 1. Simplified geologic map of a part of coastal Maine. C = Cadillac Mountain granite, G = Gouldsboro granite, and P = Pleasant Bay layered intrusion.

appear to rest unconformably on the late Precambrian and/or early Paleozoic Ellsworth schist The regional distribution of these rocks suggests that the unconformity dips gently to the southeast. Most plutons appear to be sheet-like masses that are roughly parallel to that unconformity, so that the present level of erosion exposes the floor of the plutons along their northern contacts with country rocks and their roofs along their southern contacts.

Based on gravity studies ((Hodge et al., 1982) the Gouldsboro granite appears to be about 800 meters thick and rests on top of gabbroic material. The plutons are abundantly cut by steeply-dipping mafic, granitic and composite dikes that typically trend roughly N-S. The Pleasant Bay intrusion now has a basinform shape, probably due to subsequent sinking and thickening of the pluton due to continued replenishments of dense basaltic magma (Wiebe, 1993). The presence of miarolitic cavities in all of these plutons suggests they were emplaced at shallow depths.

The metavolcanic rocks are also bimodal and may not be much older than the plutonic rocks; in some cases, they are even comagmatic with them (Seaman et al., in press). Recent U-Pb zircon ages from the nearby Cadillac Mountain intrusive complex and closely associated volcanic rocks of the Cranberry Island series are overlapping within errors.

Student Projects

The first few days were spent as a group in a general reconnaissance of the area. In that time we were able to develop a clear sense of the major problems that needed to be addressed in order to work out the overall evolution of this igneous complex. Students very cooperatively choose as their research projects those problems which we felt as a group had the highest priority. Each of their research projects had clear goals which we thought could be achieved though field, petrographic, and geochemical study. Field projects included studies of two different granitic plutons, a mafic-silicic layered intrusion, and metavolcanic rocks that formed the country rock to these plutons. Field work was undertaken in pairs with one of the students acting as leader and the other as an assistant. In this way, every student was a leader and an assistant about half of the time. Because some projects were closely related to each other, close collaborations naturally evolved between smaller groups of two or three students. The project chosen dove-tail well with ongoing work by Wiebe on other Maine plutonic rocks and by Seaman on the Cranberry Island volcanics.

Three projects focused on different areas of the Gouldsboro granite that are well exposed along the Maine coast. This granite has never been mapped or sampled in detail and appears to consist of many separate pulses of granitic magma. **Steve Adams** (Franklin and Marshall College) studied a western area that is noteworthy for containing a wide range of chilled globules of intemediate to silicic magma. **Jennifer Roberts** (Trinity University) studied a central area of this granite that provides excellent sections from the base to the top of the sheet-like pluton. **John Lien** (Colorado College) studied an eastern area characterized by zones of commingling between different magmas and cut by mafic and composite dikes.

Eva Fung (Smith College) chose to study a section within the Pleasant Bay mafic-silicic layered intrusion which lies east of the Gouldsboro granite. This intrusion consists of interlayered gabbroic and granitic rocks that record many replenishments of basaltic magma into a silicic magma chamber. Her section contains a clear upward transition from gabbro to granite and a spectacular development of silicic pipes that intrude upward into overlying gabbroic rocks.

The two remaining students focused on extremely important units that are at present very little known. **Wendy Cunningham** (Amherst College) is studying a separate pluton of rapakivi granite that was not previously shown on the state map. It is very different in texture and grain-size from typical Gouldsboro granite. Field relations suggest that it is older that the Gouldsboro. It will be particulaly interesting to compare the composition of this body with other Maine plutons. **John Phipps** (Williams Coollege) studied several areas of bimodal volcanic rocks that are the country rock for the Gouldsboro pluton. These should provide useful information on the tectonic setting prior to granite emplacement.

Three students (Cunningham, Fung, and Phipps) are presenting posters at the NE GSA meeting in Connecticut in March.