STRUCTURE

The Antigonish Basin is a structural basin containing sedimentary rocks ranging in age from Late Devonian to Late Carboniferous (Westphalian B). The present outline of the Basin is controlled mainly by northeasterly trending faults. Sedimentary contacts are preserved and undisturbed in the following two areas: along the western border near Ohio and along part of the northwestern border between Antigonish and James River. A major longitudinal fault (parallel with the Basin's axis) defines the southeastern border of the Basin. The Antigonish Thrust Fault is the most important structural feature in the Basin because it affects all post-Hartshorn Formation strata in the Basin. The major folds in the Basin are believed to be related to the Antigonish Thrust Fault.

FOLDS

The folds in the Antigonish Basin are typically, gently dipping with curved fold axes. The major fold features are probably related to fault movement with the Antigonish Thrust Fault a principal cause of major and minor folding. Small-scale folding is rarely recognized in outcrop in the Antigonish Basin. Complex and chaotic folding is evident in the Addington Formation at Monks Head. The Macumber Formation is locally tightly folded above small intraformational thrust faults such as in the Crystal Cliffs section. The Macumber Formation along the southeastern border of the Basin locally displays small-scale kink folds. The Hartshorn Formation and rocks immediately above the Antigonish Thrust Fault are inferred to have locally complex minor folding (interpreted in the cross-section on NSDME Map 82-2, in pocket).

In most areas, the strata in the Antigonish Basin define large wavelength low amplitude open folds with rare overturned and tight folds. The major folds in the Antigonish Basin include the South River, Pinkietown, Glen Road, Glen Alpine and Meadow Green synclines and the Ashdale Anticline. These folds have arcuate fold axes produced by minor cross folds. Local overturned folds are inferred to be present in the overturned Sylvan Anticline near Antigonish and in the northerly extension of the South River Syncline near Captains Pond (NSDME Map 82-2, in pocket).

FAULTS

The major faults in the Antigonish Basin may be subdivided into several general categories using criteria such as their orientation and latest apparent sense of movement. These include high-angle normal, high-angle transcurrent (wrench), high-angle transverse (listric) and thrust faults. High-angle longitudinal faults are responsible for the pronounced northeast-southwest linearity in the borders of the Antigonish Basin. The major faults of this type include the Morristown Fault and Lanark Fault along the northwestern border, the Pomquet Harbour Fault, Dunmore Fault and Glenroy Fault along the southeastern border, and the Ashdale Fault and Monks Head Fault within the central part of the Basin (NSDME Map 82-2, in pocket). Several high-angle subsidiary faults are present along the western border, but are truncated by the Antigonish Thrust Fault. The depth extension of some of the intrabasinal faults is uncertain and speculative in cross-section on NSDME Map 82-2, in pocket. They may not extend down to the basement and possibly are truncated at the Antigonish Thrust Fault.

All the high-angle longitudinal faults have components of strike and dip slip offset. The magnitude of the movement appears to decrease towards the southwest and, with the exception of the Glenroy and Pomquet Harbour faults (dextral), apparent estimated strike slip movement is typically <1 km. Dip slip movement is generally <200 m. The amount of movement on the Glenroy Fault is much greater than on the other faults, perhaps by an order of magnitude or more. The Glenroy Fault is interpreted as a nearly vertical normal or reverse fault. Outcrops of overturned Macumber Formation along the contact, together with gravity modelling by the Nova Scotia Research Foundation (1959) offer limited support for the reverse fault configuration.

Northeasterly trending longitudinal faults are also present in the Lakevale area (see inset on NSDME Map 82-2, in pocket). This fault zone may be an extension of the Browns Mountain Fault mapped in the Antigonish Highlands by Benson (1974) and Murphy et al. (1982; 1991). The longitudinal faults in the Antigonish Basin appear to be the system with the latest movement which may have occurred in the Late Carboniferous to Mesozoic. They crosscut the entire stratigraphic section, the major folds and earlier transverse and thrust faults.

Major transverse faults in the Antigonish Basin are not as common as the longitudinal faults. The Purlbrook Fault, Pomquet Station Fault and McLellan Road Fault are interpreted as listric transverse faults which have moderate to steep dips at the surface with inferred gentle dips at depth. They are probably genetically related to the Antigonish Thrust Fault. The listric transverse faults are apparently offset by the last

movement on the longitudinal fault system. Relics of transverse faults with uncertain affinity are found along the southeastern border of the Basin. At these localities the Macumber Formation is locally preserved in highly shattered northwesterly trending fault blocks.

The majority of the post-Hartshorn Formation stratigraphic succession up to and including the Port Hood Formation, has undergone significant (based upon the extent of disruption) (Fig. 46, p. 76), but uncertain, displacement on the Antigonish Thrust Fault. The magnitude of the offset cannot be determined due to the absence of displaced markers, however displacement of hundreds of metres is probable and several kilometres not unreasonable. The outcrop edge of the Antigonish Thrust is present between Captains Pond, Lower South

Figure 46a. Core slab photograph, drillhole KEH-5 at a depth of 276.8 m (908 ft), tectonic breccia consisting of shattered, finely laminated shaly limestone with interstitial selenite gypsum cement. Location is near Addington Forks. For location see NSDME Map 82-2, in pocket.

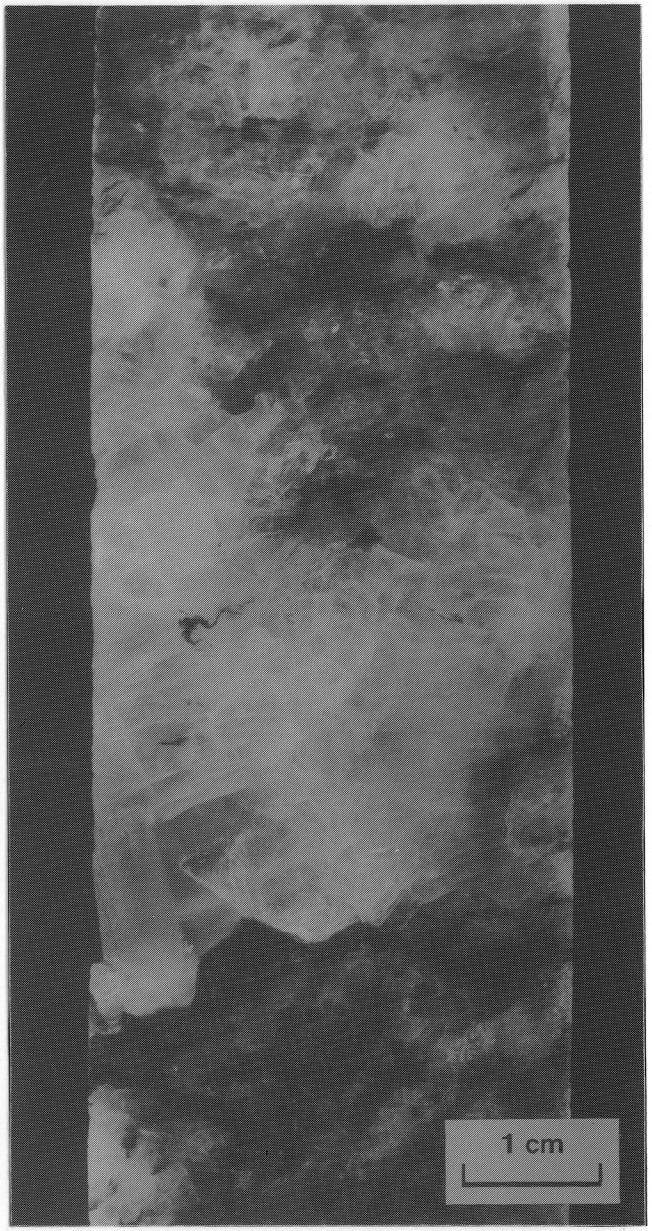

Figure 46b. Core slab photograph, drillhole NSDM 1708 (SSH-2) at a depth of 215 m (705.5 ft), highly recrystallized, coarse grained, selenite gypsum from a section in close proximity to the Antigonish Thrust Fault. Location is near Southside Antigonish Harbour. For location see Figure 28 (p. 38).

River, Antigonish, James River and Hillcrest (Fig. 4, p. 6; NSDME Map 82-2, in pocket). To the southeast, the Antigonish Thrust Fault is terminated in the subsurface against the Glenroy Fault. Boehner (1992) indicated thrust faults (decollement) similar to the Antigonish Thrust Fault were localized in the ductile incompetent evaporites of the Windsor Group (Hartshorn Formation) and were probably related to transpressive tectonics adjacent to major strike slip faults.

Depending upon the interpreted magnitude of movement, the majority of rocks (post-Hartshorn Formation) outcropping in the Antigonish Basin may be considered allochthonous. Stratigraphic and paleontological evidence (e.g. Southside Antigonish Harbour and Glen Road drillhole GR83-1) indicate that the thrust juxtaposes Hood Island and Hastings formations with Hartshorn Formation or Bridgeville Formation. The top of the Hartshorn Formation is a major decollement zone (Boehner, 1986b) causing a structurally-produced discontinuity in the stratigraphic section (e.g. drillhole GR83-1). The Addington Formation which normally should disconformably overlie the Hartshorn Formation is invariably highly disturbed structurally. It is partially to completely absent in the Southside Antigonish Harbour area and drillhole GR83-1 near Glen Road. The contact between the autochthonous and allochthonous rock packages is not resolved in the available seismic data and is only well preserved in drill core. Details of the contact are poorly known because it has rarely been drilled. The Hartshorn Formation salt is a natural, preferred thrust horizon due to its incompetence, high ductility and lubricating characteristics (Boehner, 1992).

A major impact of the Antigonish Thrust Fault is a prominent structural thinning of the basinfill. The Antigonish Basin is relatively shallow (2-3 km) in contrast to the composite stratigraphic thickness (5+ km). Stratigraphic discontinuities such as the Pomquet or Hastings formations in contact with the Hartshorn or Bridgeville formations near Williams Point and Southside Antigonish Harbour (Fig. 29, p. 39) were initially believed to be an onlap unconformity similar to that in the Loch Lomond area (Boehner, 1981b). The presence of the missing strata, especially the major carbonate members of the Hood Island Formation (e.g. E_1 Limestone) which outcrop updip from, but were not intersected in, the drilling dictated a re-evaluation of the onlap hypothesis. Thick stratigraphie units with lateral continuity were disrupted or absent at a coincident sheared and brecciated zone near the top of the Bridgeville or Hartshorn formations. Similar disruption and missing stratigraphic units at this position were subsequently identified along the western border of the Basin near Ohio (GR83-1, Fig. 15, p. 24; Fig. 16, p. 25). Seismic survey lines by Chevron Canada Ltd. (NSDNR Petroleum Resources files) allow confident identification of the Windsor Group and a general confirmation of the major longitudinal faults (e.g. Pomquet Harbour and Glenroy) as well as the basically simple structure of the Mabou (Canso) Group. The lines confirm the anomalously shallow nature of the Basin with respect to composite stratigraphic thickness. The Antigonish Thrust Fault is, unfortunately, not apparently resolved as a prominent separate reflector. This perhaps may be related to the shallow depth and its close association with the basal Windsor Group evaporites.