COMMISSION GEOLOGIQUE DU CANADA
GEOLOGICAL SURVEY OF CANADA

GEOLOGY OF THE SILURIAN SPRINGDALE CALDERA, KING'S POINT-SHEFFIELD LAKE COMPLEX AND SPATIALLY ASSOCIATED SUITES

LEGEND
FOR THE GEOLOGY OF
THE SILURIAN
SPRINGDALE CALDERA, KING'S POINT-SHEFFIELD LAKE COMPLEX
AND SPATIALLY ASSOCIATED SUITES

THE SPRINGDALE CALDERA VOLCANIC AND SEDIMENTARY ROCKS

1 Crystal-lithic tuff. The first pyroclastic eruptive tuffaceous unit of the Springdale Caldera. Welded, lithic-crystal tuff. Plagioclase and K-feldspar, accessory biotite, quartz, and rare opaques, clasts of granophyre, plagioporphyric basalt, andesite, ultrasafics, and jasper. U/Pb zircon age 432.4 +1.7/-1.4 Ma (Coyle, M. 1990, Memorial University Ph.D. Thesis, Coyle et al in prep.).

2 Mega-breccias and meso-breccias of the collapse margin of the Springdale Caldera. Includes laharic flows, agglomerates, coarse pyroclastic breccias, tuffites and pepperites, volcanic conglomerates and breccias, and minor reworked sandy horizons. Heterolithic lithic debris including basement lithologies, basaltic material and felsic volcanic debris in a matrix ranging from crystal-rich ashy material to reworked equivalents.

3 Dacitic and andesitic flows and domes associated with the eastern eruptive margin of the Springdale caldera. Includes dacitic spines, domes and vent complexes and associated carapaces; andesitic volcanic rocks, mainly lava flows and strato-volcanic affinities and some massive andesitic intrusive stocks. Dacites typically plagio-phyric, massive to flow-foliated to brecciated; andesites are glomeroporphyritic, well-bedded, massive flows.

4 Intermediate to felsic ash-flow tuff and tuff breccia evolved from a vent center in the eastern margin of the Springdale Caldera. Crystal-lithic and lapilli ash-flow tuffs; clasts of andesite, rhyolite, angular and flattened pumice; variably welded. In places has large (>64 mm) flatted pumice bombs. Feldspar-phyric.

5 Basaltic lava flow associated with the early phase volcanism and dominantly explosive volcanism of the Springdale caldera. Mainly basaltic flows, some of intermediate composition. Locally plagiophyric with amygdules of quartz, calcite and chlorite; variably altered. Note that map units include large areas of no outcrop.

5a Late stage, basaltic flow associated with post-collapse, effusive and syn-sedimentary deposition in the caldera. Plagiophyric basalts with local coarse concentrations of plagioclase. Tabular with massive basal portions and vesiculated flow top breccia.

6 Extensive silicic ash-flow tuffs which dominate the intra-caldera assemblage accumulation of the caldera. Broken two feldspars plus quartz-phyric, variable composition lithic fragments, and vitroclasts; basal lithophysae-rich horizons, grading up into a partially welded crystal-lithic lapilli tuff; flattened pumice bombs up to a metre long; variably welded.

7 Dacitic to rhyolitic ash-flow tuffs of the main explosive stage of the caldera and associate vitroclastic breccia and domes. Massive, vitric-rich, strongly welded; curviplanar joint surfaces in the domes, with internal plastic shear zones, local brecciation, and flow folds; tuffs locally porphyritic, with small euhedral plagioclase and rare quartz phenocrysts in glassy matrix.

8 Final pyroclastic eruption products generated in the Springdale Caldera. Rhyolitic ash-flow vitric tuffs and breccias. Welded, devitrified, locally massive; areas of unwelded vitroclastic tuffs with large individually devitrified shards; locally passes into reworked tuffaceous material indicating increasing periods of sedimentation. Also alternating thin basaltic and silicic bands indicate magma-mixing.

9 Red clastic sedimentary rocks of the Springdale Formation formed after explosive activity had ceased in the Springdale Caldera, which then provided a ready source for rapid erosion and deposition into the natural basin of deposition. Conglomerate, sandstone, and sandy siltstones, local caliche horizons; cross-bedding, ripples, laminations, rip-up horizons, scour channels, etc. indicate stream-flood and proximal and distal fluvatile origin; clasts essentially volcanic or plutonic provenance.

10 Crystal-rich ash-flow tuff deposited into the Springdale Caldera, intra-caldera facies (units 1-9) but derived from an eruption in the King's Point complex. Crystal-lithic tuff. Densely welded and massive large phenocrysts of quartz and feldspar, clasts of mafic and rare ultramafic lithologies. U/Pb zircon age 425 +/-3 Ma (Coyle, M. 1990, Memorial University Ph.D. Thesis, Coyle et al in prep.).

SPRINGDALE CALDERA INTRUSIVE ROCKS

E Microdioritic plug which is the remnant of a core of a strato-volcano on the eastern margin of the caldera. (Associated with Units 1-3). Massive, black and fine-grained.

F Felsic sill and associated dykes associated with the eastern strato-volcanic center. Micro-porphyritic, pink with grainy to glassy texture, in part flow banded.

G Rhyolite domes and dykes produced in the late stages of caldera evolution, represent the cessation of explosive volcanism and shift to effusive and intrusive magmatism. Fine, glassy massive to flow foliated, auto-brecciated, lithophysae and spherulitic devitrification. High-silica. U/Pb zircon age 430.8 ±2Ma (Coyle, M. 1990, Memorial University Ph.D. Thesis, Coyle et al in prep.).

THE KING'S POINT AND SHEFFIELD LAKE COMPLEXES, VOLCANIC ROCKS

11 Red and brown crystal-vitric and lithic-rich, extensive ash-flow sheets which makes up the lowest, preserved pyroclastic member of the two volcano-plutonic centers. This unit is variable and includes associated laharic breccias, rhyolitic domes, and dykes and minor basaltic material.

12 Massive maroon, aphanitic to feldspar-phyric, flow-banded ash-flow tuff, which dominates the southern portions of the King's Point Complex. May be correlative to unit 11 and/or the upper portion of unit 11 found in the Sheffield Lake area. This tuff may be the extrusive equivalent of intrusive unit I.

12a High silica, ash-flow tuff (ignimbrite) with peculiar sodic metasomatism. Orange to purple or white; chactered by large sodic amphibole and hematite oikocrysts. Produced by extreme hydrothermal alteration and carbonatization/albitization of the silica-rich peralkaline unit, associated calcite fluorite veins.

13 Late stage andesitic volcanism associated with the Sheffield Lake Complex. This unit is aphyric to feldspar-microphyric, massive and contains inclusions of the Topsails granite. This unit is not preserved in the King's Point Complex.

KING'S POINT AND SHEFFIELD LAKE INTRUSIVE ROCKS

H Medium-grained pink to red porphyritic syenite and alkali syenite with variable quartz and/or mafic inclusions. This body composes the central plutonic assemblage of the King's Point complex.

Ha Alkali feldspar granite and quartz syenite, feldspar and amphibole-phyric. Locally peralkaline, and heavily altered; spatially distributed along regional large-scale faults in both complexes. U/Pb zircon age date 427 +2 Ma (Coyle, M. 1990, Memorial University Ph.D. Thesis, Coyle et al in prep.).

I Quartz-feldspar porphyry. Orange to green high-level intrusive suite composing a ring dyke system in the northern and southern margins of the King's Point Complex and distributed along an intrusional fracture in the Sheffield Lake Complex. These porphyries are typical of the deeper portions of cauldron and caldera settings, and typically mark the location for vent complexes associated with explosive volcanism. This unit includes intrusive breccia, and flow banded and foliated dykes. Sodic amphibole oikocrysts, minor aegrine and altered fayalite. Also associated with calcite and fluorite veins.

BASEMENT LITHOLOGIES OF THE SPRINGDALE CALDERA
KING'S POINT AND SHEFFIELD COMPLEXES

P Precambrian basement located to the west of the King's Point Complex and Baie Verte Fault Zone. Dominantly fine to medium grained psammitic and semipelitic schist and gneiss.

BV Variety of rock types found along the Baie Verte fault zone. Dominantly the Flatwater Group, Ordovician pillow lavas, sglomerates and argillites.

LB Lush's Bight Group. Mafic, ophiolite-related submarine volcanic rocks typically dark to light green pillow lavas, pillow breccias, aquagene tuff, sheeted dikes, dykes and gabbro. Located throughout the Springdale Peninsula between Hall's Bay and Southwest Arm and along the eastern side of the King's Point Complex.

CP Catcher's Pond Group. Mafic, ophiolite-related submarine volcanic rocks, and associated dominantly by acid volcanic rocks and sedimentary clastic rocks. Located between the southern part of the King's point Complex and western basement of the Springdale caldera.

RA Robert's Arm Group. Mafic to felsic submarine volcanic rocks, predominantly, green to greyish-green intermediate to basaltic lava and associated breccias and epiclastics; grey-green felsic tuffs, rhyolite to dacite flows, cherts and ... and sedimentary rocks, and associated Ordovician suites. Located east of the Springdale Caldera along fault bounded blocks and may have provided some detrital material to the early collapse phases preserved in the topographic margin of the caldera.

BASEMENT LITHOLOGIES INTIMITELY ASSOCIATED WITH THE SPRINGDALE CALDERA AND KING'S POINT-SHEFFIELD LAKE COMPLEXES

A. Amphibolite, diorite, granodiorite, granite. Foliated amphibolite and gabbro occurring as large screens and xenoliths in foliated diorite and granodiorite; intruded by variably deformed tonalite and amphibolite-biotite granite; intruded or net-veined by a pale fine-grained granite. This unit includes the Burlington Granodiorite, Hungry Mountain Complex, Mansfield Cove Pluton.

B. Granodiorite, diabase, gabbro and dorite. May in part be correlative with the Twin Lakes Complex, and includes the Topsail diorite and Twin Lakes Complex.

INTRUSIVE COMPLEXES GENETICALLY RELATED TO THE EVOLUTION OF THE SPRINGDALE CALDERA AND THE KING'S POINT-SHEFFIELD LAKE COMPLEXES

C. Topsails Complex. White to red medium to coarse grain equigranular granite with amphibole ± pyroxene; granite, quartz monzonite and granodiorite. Includes the Hall's Bay Pluton, Dave's Pond and Skull Hill granites. The Topsails Complex is a resurgent pluton beneath the Springdale Caldera and domes its southern margin.

D. Offshoots of the Topsails Complex. Granite, medium to coarse grained. Characterized by quartz and pink feldspar, with finer crystals of black amphibole, intruded by finer grained whitish-grey granite with locally riebeckitic segmatite and abundant amphibole-lined miarolitic cavities and fracture. Generally associated with the margins of the Topsails Complex, but also includes extensive bodies to the north of Sheffield Lake Complex and west of the Springdale Caldera.

SILURIAN AND YOUNGER SEQUENCES IN THE VICINITY

14 Micmac Lake Group. Predominantly red to grey rhyolitic flows, tuffs and agglomerate, dark amygdaloidal basaltic flows, minor conglomerate and sandstone. This group is genetically related to the evolution of the volcanic terrain of the Springdale-King's Point Complexes, but needs further mapping for proper volcano-plutonic reconstruction.

15 Carboniferous basins. Poorly indurated red and grey conglomerate and sandstone, grey shale and siltstone and minor limestone. These deposits occur sporadically across the surface of the Silurian volcanic terrain in this area.

Bedding, inclined; tops known, unknown

Flow banding and welding orientation, inclined

Primary igneous layering, inclined, vertical

Volcanic vent area

Synclinal axis, interpreted

Geological compilation by Marylou Coyle, 1991

Geology by Marylou Coyle and David Strong (1984-90), with additional information from Kean et al., (1977); Hibbard, (1983); Whalen and Currie, (1983); Mercer et al., 1985; Kontak and Strong, (1986); Kean (1988). Geophysical information was provided by T.Herd of Equity Silver Mines, and M.Riecha of Teck Exploration Limited

Scale 1:100 000 - Échelle 1/100 000

Kilometres 0 1 2 3 4 5 Kilometres

Universal Transverse Mercator Projection
© Crown copyrights reserved

Projection transverse universelle de Mercator
© Droits de la Couronne réservés

MARGINAL NOTES

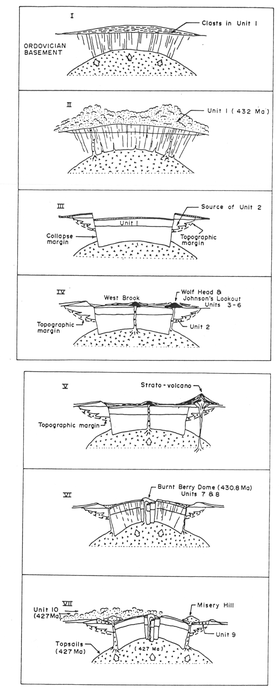
The geology of the Silurian volcano-plutonic complexes of west-central Newfoundland, although extremely important in a regional context, have had substantially less attention historically than the older, dominantly submarine suites of the Dunnage terrain.

The Springdale Caldera and the King's Point-Sheffield Lake Complexes, together with the Topsails Complex, Micmac Lake Group, and the Cape St. John and Sop's Arm Groups, make up part of an extensive early Silurian volcanic field, termed the Springdale Volcanic Field (Coyle, 1990). The volcano-plutonic events of the Springdale Volcanic Field took place over a 5 Million year period in the early Silurian, between 434-415 million years, dated by the author using U/Pb, zircon geochronology.

The scale of these calderas and their abundant highly-siliceous volcano-plutonic rocks, and associated high-level plutonic suites, suggest that they were formed in a substantially thickened epi-continental type of crustal regime, produced through the crustal thickening following closure of the Cambro-Ordovician Iapetus Ocean.

The Springdale Caldera comprises a sequence of intra-caldera pyroclastic ash-flow tuffs, marginal caldera collapse breccias (mega- and meso-breccias) and associated sediments, vent and dome complexes, strato-volcano, and epiclastic debris associated with each of the primary igneous units. Post-explosive products include sedimentary infill rocks and effusive mafic volcanic flows, which mark the waning stages of volcanism and a shift to a dominantly intrusive regime marked by late-stage, high-level intrusive bodies related to resurgence of the caldera.

Seven main stages of volcanism can be characterized for the evolution of the Springdale Caldera, as summarized in the figures below:



The King's Point and Sheffield Lake Complexes share a similar volcano-plutonic evolution with that of the Springdale Caldera. However, because these complexes are exposed at a deeper structural level, the plutonic facies dominate these terrains. The King's Point Complex comprises a sequence of syenites, granites, high-level porphyries and associated pyroclastic ash-flow tuffs. Two striking aspects of this complex are seen in the marginal ring-dyke exposed in the northern part of the area, which acted as a conduit for the eruption of the ash-flow tuffs and then subsequently plugged by the viscous, less-volatile magma; and the spectacular abundance of metasomatized co-magmatic ignimbrites and porphyries.

The Springdale Caldera and King's Point-Sheffield Lake Complexes occur near the western margin of Newfoundland's lower Paleozoic mobile belt, where a series of large-scale regional faults is found, which reflect various stress regimes with time.

The most important and continuous fault system in this area is the Long Range-Baie Verte Fault System, known as the Cabot Fault. The Cabot Fault splays into a number of branches, which will be referred to as the Cabot Fault Zone.

There are five splays of the Cabot Fault System, which are important for understanding the Silurian magmatic activity of this area. They are named from west to east: the Doucer's Valley, White Bay, Baie Verte, Green Bay, and Lobster Cove Faults. For the purposes of this map, the Baie Verte Fault separates the Micmac Lake Group from the Springdale Caldera, and is affected by movement on the Baie Verte Fault. Furthermore, evidence that clasts of volcanic material from the King's Point Complex are found in the Micmac Lake volcanics suggests that they are younger than the King's Point Complex. It is therefore more probable that the Micmac Lake Group is correlative with the late Silurian Sop's Arm Group and associated intrusive suites which make up the Sop's Arm Caldera. Using this interpretation, it means that post-Silurian movement on the Baie Verte Fault was mainly vertical, ie: forming the east side of the Fleur de Lys Horst.

The Green Bay Fault is found along the shore of Green Bay, exposed as a steep scarp in excess of 330 metres where the eastern margin of the King's Point Complex is juxtaposed against the Lush's Bight Group ophiolitic rocks. The higher altitude of the west side of the fault accords with vertical uplift along it, but it appears that its dextral motion is more important, with evidence for at least 25 km and up to a maximum of 100 km dextral motion. As suggested in the reconstructive illustration found on the map, such displacement would allow for the juxtaposition of the Springdale Caldera and Cape St. John Group, which along with other evidence implies that their origin may have been related to the same caldera

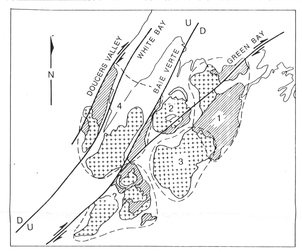
evolution. Support for this displacement on the Green Bay Fault is also given by the compelling similarities between the oikocrystic comendites and porphyries of the King's Point Complex and the Sheffield Lake Group (Coyle et al, 1986). The similarity between these unique rocktes strongly suggests that the two were part of the same King's Point Caldera, which was also dissected and displaced about 50 km by the dextral movement along the Green Bay Fault. This fault was also active until at least the lower Carboniferous, as seen by deformation of Lower Carboniferous strata along its full extent.

The Lobster Cove Fault: in the Springdale area the Lobster Cove Fault can be seen in cliff faces as a gently northward-dipping thrust fault. The author recognized two new features of this fault during the field work associated with her Ph.D. thesis and work toward this map. The Lobster Cove Fault steps several mappable units of the Springdale Group, ie: Sandstones (Unit 9), basaltic flows (Unit 5a), and the interbedded Indian River ash-flow tuff (Unit 10). Furthermore, it exhibits a number of splays which separate imbrications within a duplex structure of the Lush's Bight Group, formed by ramping at a bend in the fault.

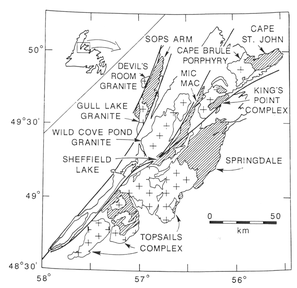
A detailed map of the northern margin of the Springdale Caldera shows a foothill-shaped structure to the north of the Lobster Cove Fault, which encloses marginal fault blocks of the caldera. This feature comprises a complex assemblage of juxtaposed fault blocks disposed about an asymmetrical fold axis with an axial planar fault axis, all of which is sandwiched between the Lobster Cove Fault to the south and several west-west trending faults which divide this duplex from others in the Cutter's Pond Group to the north (Coyle and Strong, 1986). Along its western extension, the Lobster Cove Fault changes orientation to a more north-south direction, parallel to the central axial vertical faults in this area, and may also change in sense of movement.

All of the fault patterns described above are reflected in the smaller-scale faults within the Springdale Caldera and King's Point-Sheffield Lake Complexes. For example, a number of thrust faults are found within the upper-late caldera infill sedimentary rocks in the Springdale Group. Two thrust faults truncate the sedimentary trends and are clearly visible on geophysical maps produced in this area. The northernmost of these developed along the Burnt Berry syncline, which it cuts, and displaces along its southernmost extent. The southern of the two marks the approximate southern boundary of the red-bed caldera infill. Local strike/slip offset in a number of units of the King's Point Complex and Sheffield Lake Complex.

Deformation in these complexes is neither pervasive nor extensive. Little evidence of deformation is seen in the King's Point-Sheffield Lake Complex, except along obvious major faults, or related to intrusive histories. Deformation of the Springdale Group was dominated by one major fold, an open syncline with its axis trending southeastward through the western part of the caldera. As mentioned above, episodes of thrust/strike-slip faulting are also found in the Springdale Caldera and between the King's Point and Sheffield Lake Complexes. Large-scale caldera-related block faulting is seen along both margins of the Springdale Caldera and resurgent doming and associated block faulting along the southern margin of the Springdale Caldera.



Configuration of the Springdale-King's Point region in early Silurian time, showing major faults.
1-Springdale caldera; 2-Kings Point complex; 3-Wild Cove Pond and Gull Lake plutons; 4-Topsails complex



Present configuration of the Sprindale-Kings Point region

References

Coyle,M. and Strong,D.F. 1987. Geology of the Springdale Group: a newly recognized Silurian epicontinental-type caldera in Newfoundland. Canadian Journal of Earth Sciences 24. p.1135-1148

Coyle,M., Strong,D.F., and Dingwell,D.B. 1986. Geology of the Sheffield Lake area. Geological Survey of Canada Paper 86-1A, p.455-459

Hibbard,J. 1983. Geology of the Baie Verte peninsula, Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Memoir 2, 279 p.

Kean,B.F. 1977. Geology of the Victoria Lake map-area (12A/6), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division Report 77-4, 11 p.

Kean,B.F., and Evans,D.T.W. 1988. Regional metallogeny of the Victoria Lake Group, Newfoundland Department of Mines, Mineral Development Division, Report 88-1, p.119-130

Kontak,D.J. and Strong,D.F. 1986. The volcanic-plutonic Kings Point complex, Newfoundland. Geological Survey of Canada Paper 86-1A p.465-470

Mercer,B., Strong,D.F., Wilton,D.H.C., and Gibbons,D. 1985. The King's Point complex, western Newfoundland. Geological Survey of Canada Paper 85-1A, p.737-741

Whalen,J.B. and Currie,K.L. 1988. Geology, Topsials Igneous Terrane, Newfoundland. Geological Survey of Canada Map 1680A

OPEN FILE
DOSSIER PUBLIC
2456
GEOLOGICAL SURVEY OF CANADA
COMMISSION GEOLOGIQUE DU CANADA
OTTAWA
1992

This map has been reprinted from a scanned version of the original map
Reproduction par numérisation d'une carte sur papier

Contribution to Canada-Newfoundland Mineral Development Agreement 1984-1989, a subsidiary agreement under the Economic and Regional Development Agreement. Project funded by the Geological Survey of Canada

Contribution à l'Entente auxiliaire Canada/Terre-Neuve sur l'Exploitation minérale 1984-1989 faisant partie de l'Entente de développement économique et régional. Ce projet a été financé par la Commission géologique du Canada

DEPARTMENT OF MINES AND ENERGY
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Canada