

BUCHANS MAP AREA (12A/15), NEWFOUNDLAND

by B.F. Kean

INTRODUCTION

During the 1978 field season, 1:50,000 geological mapping was completed in the Buchans map area (12A/15). Compilation for much of the Buchans Group in the west half of the area awaits a reinterpretation of the stratigraphy and structure by Price-Asarco.

The southern part of the map area can be reached by the Buchans Highway (Route 50) from the Trans Canada Highway at Badger. Privately owned logging roads provide local accessibility to those parts of the map area south of Red Indian Lake. Red Indian Lake and the Exploits River provide additional but restricted accessibility. The northern part of the map area is accessible only by helicopter.

The Buchans map area has been previously mapped at 1:250,000 scale by Williams (1970). The area has been mapped in detail by ASARCO and much of the data has been compiled on unpublished 1:50,000 scale maps by F. Anderson of the Geological Survey of Canada. The immediate mine vicinity has been the subject of a number of detailed studies and university theses (e.g. Relly, 1960; Thurlow, 1973).

Exposure in the map area is generally poor. The map area has an extensive till cover with boulder terrain developed in places in the Topsails. Mapping and the understanding of the geology is further hampered by abrupt lateral facies changes, lack of marker beds, and the lack of cleavage - bedding relationships.

GENERAL GEOLOGY

The map area is underlain by three contrasting geological terrain - Hungry Mountain Complex, the Buchans and Victoria Lake Groups, and the Topsail Granite and its extrusive equivalents. The Buchans

Group, a complex volcano-sedimentary sequence, is bounded to the north, west and east by plutonic rocks of the faulted and deformed Hungry Mountain Complex and by the later Topsails intrusive rocks.

The Buchans Group is bounded to the southeast by volcanogenic sediments of the Victoria Lake Group (Mercer 1978). Relationships between the two groups are not exposed and are obscured by till-covered topographic depressions and faulting. However, the Buchans Group is currently considered to overlie conformably the Victoria Lake Group. This is based on regional stratigraphic correlations and a conformable contact between the Victoria Lake Group and lithologies similar to the Buchans Group in the Lake Ambrose map area (12A/10) (Kean, 1977). The Victoria Lake Group has a penetrative foliation developed whereas the Buchans Group has only a widely spaced fracture cleavage; however, no structural discontinuity is evident.

Argillite and slate equivalents of the Victoria Lake Group exposed along the Exploits River to the east of the map area contain Caradocian graptolites (Williams, 1970; D. Skevington, personal communication). Limestone lenses in graywackes below the slates south of Buchans Junction contain conodonts of latest Llanvirnian age (Stouge, unpublished report). The Buchans Group is thus considered to be Late Ordovician and/or Silurian in age.

Red, indurated, cross-bedded, ripple-marked and mud-cracked, micaceous sandstones which are lithologically similar to the Silurian Botwood and Springdale Groups are faulted, with unknown displacement, against presumed basal basaltic rocks of the Buchans Group in the Lake Ambrose map area (12A/10) (Kean, 1977) and in places in the Buchans map area. The Botwood and Springdale Groups stratigraphically overlie volcanic rocks of the Buchans Group type in Notre Dame Bay.

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This implies either a major significance for this fault in the map area or may imply a facies correlation of the Buchans Group and part of the Victoria Lake Group.

Hungry Mountain Complex (Unit 1)

The Hungry Mountain Complex underlies a narrow east-west zone in the middle of the map area and for the most part separates the Buchans Group from the Topsails Granite. Its eastward and northwestward extensions are not known. It was mapped as part of the Topsails Granite by earlier workers, but was separated and named the Hungry Mountain Complex by Thurlow (1975).

The Hungry Mountain Complex consists of an assemblage of deformed plutonic rocks that overthrust the Buchans Group. The subsequent intrusion of the Topsails Granite separates the Complex into two belts - the western and eastern belts. The complex can be subdivided into two main phases - an earlier mafic (gabbro-diorite) phase and a later felsic (tonalite, granodiorite, to granite) phase. The mafic phase (Unit 1a) is areally less extensive than the felsic phase. The mafic rocks vary from gabbro to diorite and from fine to medium grained although they are coarse grained in places. Mesoscopically, the rocks consist of equigranular plagioclase, hornblende, and pyroxene. Quartz and biotite are present in the dioritic phases. The gabbro is permeated in places by veins and zones of plagioclase-rich rock which grade into the host, and was subsequently intruded and veined by the felsic phases. The fine grained dioritic rocks are concentrated in the western belt and the medium grained gabbroic rocks in the eastern belt. The development of an S-fabric is weak or absent in these rocks.

Tonalitic to granitic rocks (Unit 1b) form the bulk of the Hungry Mountain Complex. In the eastern belt these rocks are mainly medium to coarse grained with plagioclase (45%), quartz (25%), and hornblende (30%). A weakly developed S-fabric is discernible in places.

The felsic rocks of the western belt are mineralogically and texturally more varied and generally contain potassium feldspar and hornblende. They generally have a well developed S-fabric. Xenoliths of fine grained mafic rocks of unknown origin are common.

The Hungry Mountain Complex overthrusts the Buchans Group with associated mylonitization in the fault zone. A metamorphic aureole showing prograde metamorphism up to upper greenschist facies is developed in the Buchans Group below the thrust. Thurlow (personal communication) reports the development of small scale recumbent folds in this aureole which suggest thrusting from the north-northwest to the south-southeast. Thurlow (1975) stated that the complex had

undergone a polyphase deformational history prior to emplacement. This is not evident from the present author's mapping, although the development of the S-fabric is considered preemplacement.

The complex is intruded by the Topsails Granite. Undeformed, red, feldspar porphyritic and aplitic dikes cut the thrust zone.

Victoria Lake Group Equivalent (Unit 2)

Unit 2 is an interbedded sequence of volcanogenic graywacke, and gray and black siltstone, argillite and slate with minor red argillite. A northeast trending, steeply dipping S-fabric is generally developed. It is considered laterally equivalent of the Victoria Lake Group as defined in the Lake Ambrose map area (for further descriptions, see Mercer, 1978).

Buchans Group

The Buchans Group is a complex sequence of volcanic and sedimentary rocks deposited in a unstable environment. It is divided into lower and upper subgroups (Figure 1) (Thurlow, 1975), each consisting of a number of mappable formations. Formational names, taken from PRICE-ASARCO, are informal, and are here grouped into map units of similar lithology.

Lower Buchans subgroup (Units 3-5)

The base of the Buchans Group consists of a thick sequence of northeast trending, north dipping and facing basaltic pillow lava, pillow breccia, tuff and breccia known as the Basal Footwall and Footwall Basalt (Thurlow, personal communication) (most of Unit 3). Chert, siltstone, lithic arkose and minor felsic volcanic rocks (Unit 3a) are areally less abundant within the formation. A small lens of green quartzose sandstone (Unit 3b) is interbedded with pillow lava on the north side of Red Indian Lake. The formation is sheared and brecciated along faults by the south side of Red Indian Lake and extensive hematitization is common in these zones. A small lens of red cross-bedded sandstones occurs in fault contact with the formation in this area.

Outside of the map area this formation hosts the Skidder prospect - a small, stratiform massive sulphide deposit associated with intercalated jasper in basalts.

Some of the basaltic breccias and pyroclastic rocks of Unit 3 north of Wiley's Brook may be part of the Lake Seven Basalt (Thurlow, personal communication) of Unit 5.

Conformably overlying the Footwall Basalt in the east and interfingering with it in the Buchans area is the Footwall Arkose (Unit 4). It is a dominantly sedimentary sequence which strikes east to northeast and dips

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LEGEND

CARBONIFEROUS (?)

- 12** *Poorly indurated, red and gray sandstone and conglomerate.*

SILURIAN AND DEVONIAN

- 11** *Topsails Granite: 11a, Pink to brick red, fine grained, equigranular, alkali feldspar granite and syenite; 11b, medium grained, equigranular, peralkaline granite.*

SILURIAN (?)

- 10** *Springdale Group (?): Ignimbrite, crystal tuff, breccia, and flow banded rhyolite.*

LATE ORDOVICIAN AND SILURIAN

Intrusive rocks

- 9** *Altered green felsic intrusion.*
- 8** *Fine grained equigranular diabase and gabbro.*
- 7** *Feeder Granodiorite: Medium grained pink granodiorite.*

Buchans Group

Upper Buchans Subgroup

- 6** *Unseparated mafic to felsic breccia, tuff and lava.*

Lower Buchans Subgroup

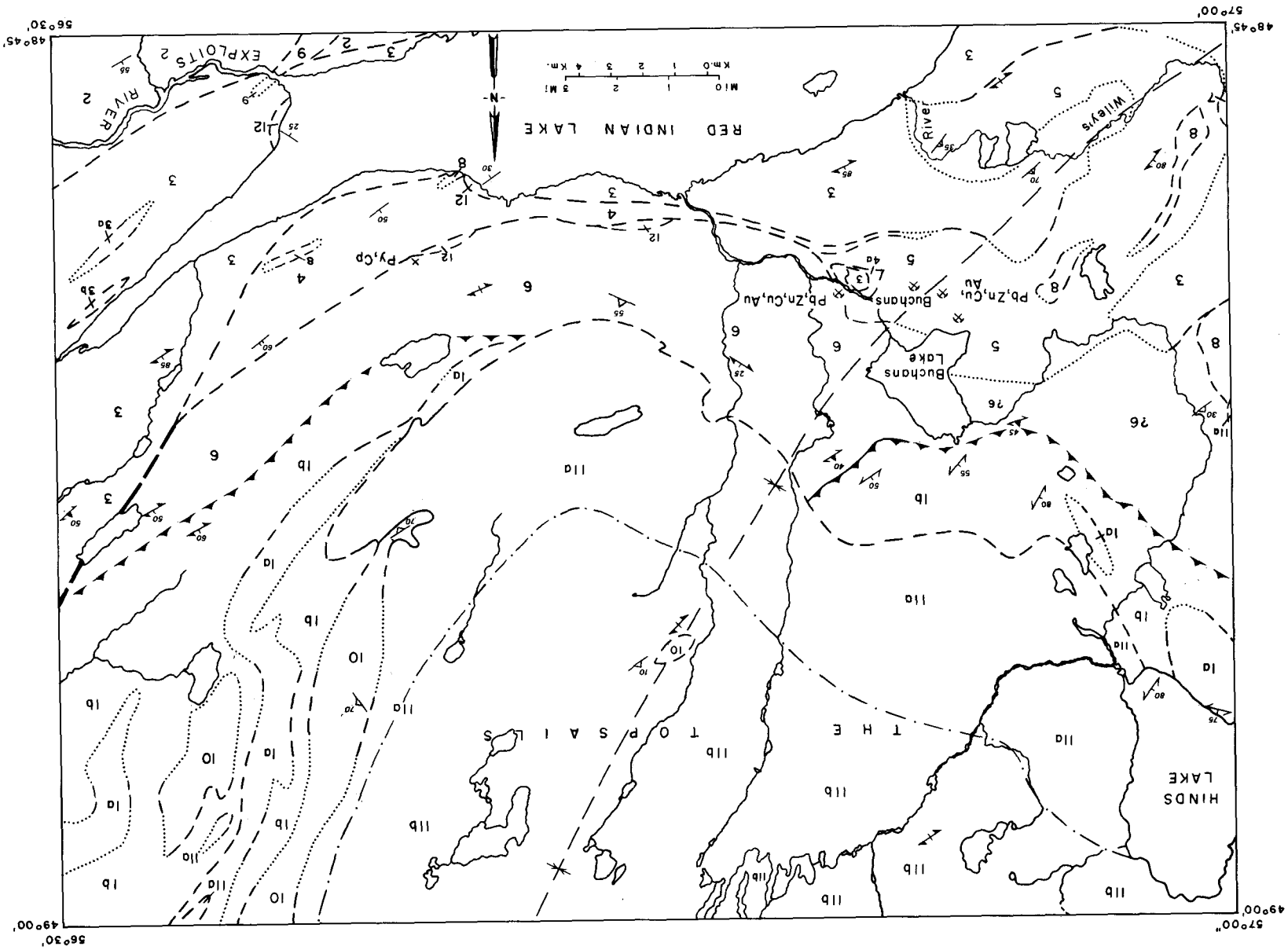
- 5** *Dacitic breccia, tuff and quartz-crystal tuff; rhyolite; intermediate and mafic pyroclastics, breccias and flows; (includes Intermediate Footwall, Lucky Strike Ore Horizon Sequence, Prominent Quartz Sequence, Ski Hill Formation, Oriental Intermediate Footwall, Oriental Ore Horizon Sequence and parts of Lake Seven Basalt).*
- 4** *Footwall Arkose: Tuffaceous graywacke and siltstone, chert, conglomerate and tuff; 4a, arkose.*
- 3** *Basaltic pillow lava, pillow breccia, pyroclastic breccia, tuff, minor red chert and minor intercalated unit 4: (includes undivided Basal Footwall, Footwall Basalt and Lake Seven Basalt); 3a, felsic volcanics; 3b, green quartzose sandstone.*

ORDOVICIAN

- 2** *Victoria Lake Group equivalents: Slate, siltstone, argillite and graywacke.*

EARLY PALEOZOIC (?)

- 1** *Hungry Mountain Complex: Foliated plutonic rocks; 1a, gabbro and diorite; 1b, tonalite, granodiorite and granite.*



and faces to the north. The formation consists of interbedded tuffaceous graywacke, siltstone, sandstone, chert and conglomerate in the east and massive arkosic rocks (Unit 4a) in the Buchans area. Clasts of pink rhyolite are characteristic of the clastic rocks of this formation.

Unit 5 includes a number of discontinuous formations. A brief description of each follows. The Intermediate Footwall, which conformably overlies the Footwall Arkose and disconformably overlies the Footwall Basalt, is a basaltic to dacitic sequence of flows, breccia and tuff and forms the host for the stockwork mineralization beneath the major massive sulphide deposits at Buchans (Thurlow, 1975).

The Intermediate Footwall is overlain by the Lucky Strike Ore Horizon Sequence consisting of pyritic siltstones that were deposited in depressions and overlain by dacitic crystal-vitric tuffs, subaqueous pyroclastic flows, granite and sulphide bearing debris flows, and rhyolite. This sequence hosts the Lucky Strike, Rothermere and MacLean ore bodies and the Clementine prospect. Overlying the Lucky Strike Ore Horizons Sequence are the basaltic lava and pyroclastic rocks of the Lake Seven Basalt unit.

A thrust fault separates the above discussed formations from the structurally overlying Prominent Quartz Sequence, Ski Hill formation, Oriental Intermediate Footwall and Oriental Ore Horizon Sequence (Thurlow, personal communication). The Prominent Quartz Sequence is a sequence of quartz-rich dacitic breccia and tuff and minor mafic flows. It is overlain by the andesitic breccias, flows and pyroclastic rocks of the Ski Hill formation, which may be laterally equivalent to the Intermediate Footwall (Thurlow, 1975).

The Oriental Intermediate Footwall of basic volcanic rocks and Oriental Ore Horizon Sequence overlie the Ski Hill formation. The Oriental Ore Horizon Sequence hosts the Oriental 1, Oriental 2, and possibly the Old Buchans ore bodies. It is a sequence of dacitic tuffs and breccias, subaqueous pyroclastic flows, granite and sulphide bearing debris flows, hematitized aphyric, feldsparphyric and flow banded rhyolites.

Upper Buchans subgroup (Unit 6)

The Upper Buchans subgroup overlies conformably the Lower Buchans subgroup. It is undivided although a number of distinct lithologies occur within it. Basaltic pillow lavas and pyroclastic rocks with minor sedimentary rocks form most of the base of the sequence. In the area of the Oriental mines they appear to interfinger with polymictic arkosic conglomerate. Green dacitic breccia and tuff and minor flow banded rhyolite and quartz porphyritic black rhyolite are the dominant rock

types east and west of Buchans. Flow banded rhyolite and rhyolite breccia are common west of Buchans Lake.

Intrusive rocks

Feeder Granodiorite (Unit 7)

The Feeder Granodiorite is a medium to coarse grained, pink granodioritic body underlying an area to the southwest of Buchans. It is characterized by equant and rounded or resorbed quartz phenocrysts up to 1.5 cm across and by strongly zoned plagioclase. It is texturally and geochemically similar to volcanic rocks within the Buchans Group. Clasts of similar lithology to the Feeder Granodiorite occur in portions of the Buchans Group, although it intrudes the Buchans Group. The Feeder Granodiorite is thus interpreted to have fed the Buchans Group and is considered to be the earliest intrusion in the map area.

Diabase and Gabbro (Unit 8)

Fine grained diabase and medium grained, equigranular gabbro are common within the Buchans Group. They occur mainly as elongated dikelike bodies. One of the gabbro bodies on the western margin of the map area is cut by the Topsails Granite.

Felsic intrusion (Unit 9)

An elongated body of altered, green, medium grained quartz monzonite has intruded Units 2 and 3 south of Red Indian Lake. It is lithologically similar to felsic intrusions within the Victoria Lake Group (Mercer, 1978).

Springdale Group (?) (Unit 10)

Maroon and buff colored flow banded rhyolite, ignimbrites and feldspar-crystal tuff of similar lithology to the volcanic rocks of the Springdale Group (Kalliokski, 1953) occur as roof pendants and extrusive equivalents of the Topsails Granite in the map area. These volcanic rocks locally contain riebeckite and are cut by red quartz-feldspar-riebeckite porphyritic dikes in places. Red alkali feldspar granite, red and purple feldspar porphyry, and aphyric flow banded "rhyolite" dikes cut the volcanic rocks outcropping in the northeastern part of the map area.

Topsails Granite (Unit 11)

The Topsails Granite underlies the north central portion of the map area. It intrudes the Hungry Mountain Complex, the Buchans Group and the thrust fault which separates these two units. The granite can be readily divided into two major phases - an alkali feldspar

phase and a peralkaline phase. Gabbro, diabase and diorite with mild alkaline affinities form an early phase associated with the alkali feldspar granite. The alkali feldspar phase (Unit 11a) consists of a fine grained granite and a syenite which is poor in mafic minerals and contains brick-red hematitized feldspar. The mafic minerals are hornblende and biotite. This phase forms the outer contact zone of the Topsails Granite, is miarolitic in places, and contains minor fluorite.

The peralkaline phase (Unit 11b) forms the northern core area of the Topsails Granite in the map area. This phase is a medium grained, equigranular, plagioclase-quartz-riebeckite (and/or aegerine) granite. The relationship between the two granites is not fully understood, although riebeckite bearing white aplitic dikes cut a medium grained, equigranular, hastingsite-biotite granite in the Hinds Lake area. This granite is texturally similar to the peralkaline granite and mineralogically similar to the alkali feldspar granite. The peralkaline granite is interpreted to be a younger genetically related phase of the alkali feldspar granite.

Late diabase dikes cut all phases of the Topsails Granite, including the aplitic and porphyritic dikes.

Carboniferous (?) (Unit 12)

Poorly indurated red and gray conglomerate and sandstone are exposed as small outcrops along the shores of Red Indian Lake. They rest with angular unconformity upon the Buchans Group and contain clasts of the underlying rocks.

STRUCTURE AND METAMORPHISM

The earliest structural event in the map area is a period of southward directed thrust faulting (Thurlow, 1975). This resulted in structural repetitions within the Buchans Group and overthrusting of the Hungry Mountain Complex on the Buchans Group. Fault zones along Red Indian Lake may also be related to this event; however, there has been subsequent movement on them.

Following the emplacement of the Topsails Granite the area was folded into a large open northeast trending syncline, the axis of which can be traced into the Springdale Group to the north. The development of a weak, subvertical, widely spaced fracture cleavage accompanied this deformation.

Metamorphism is subgreenschist facies in the Topsails Granite and most of the Buchans Group. Lower greenschist facies metamorphism is developed in the Buchans Group in the southwest (Thurlow, 1975) and in fault zones. The Hungry Mountain Complex has been metamorphosed to greenschist facies.

ECONOMIC GEOLOGY

All of the economic deposits in the map area occur within the Lower Buchans subgroup. They are all "volcanogenic sulphides" and belong to three distinct but genetically related types; namely, (1) stockwork ore, (2) *in situ* syngenetic massive sulphide ore, and (3) mechanically transported breccia ore (Thurlow, 1975). Practically all ore production has come from the syngenetic massive sulphide and mechanically transported breccia ore (Thurlow, 1975).

Stockwork ore consists of a network of sulphide veins in a strongly altered volcanic host. They are interpreted to feed, and in places are associated directly with, the syngenetic massive sulphide ore. The stockwork ore consists of a sphalerite, galena and chalcopryrite mineral assemblage but except for copper the grade is lower than the syngenetic massive sulphide ore. The Engine House, the Two Level Footwall and part of the West Orebodies belong to this type (Thurlow, 1975).

The *in situ* syngenetic massive sulphide ore consist of a fine grained, high grade assemblage of galena, sphalerite, lesser chalcopryrite, pyrite and trace silver and gold (Thurlow, 1973). This type includes such deposits and prospects as Lucky Strike, Oriental 1, part of West Orebody, Rothermere Footwall Orebody, and Mudhole.

The mechanically transported breccia ore is derived from slumping of semiconsolidated massive sulphide ore. They are essentially subaqueous debris flows. The MacLean, Rothermere, Oriental 2, Two Level Orebody, and Old Buchans Orebodies and Clementine Prospect are of this type.

The Upper Buchans subgroup contains no known economic mineralization. Pyrite and in places chalcopryrite mineralization occur in some of the felsic volcanics of this unit. A small tonnage, low grade, stratiform pyritic copper prospect (Little Sandy) occurs in intermediate to felsic breccias of this unit.

Alkali feldspar and peralkaline granites are commonly associated with epigenetic fluorite, tin, tungsten and uranium mineralization. The Topsails Granite, in particular, the peralkaline phase, should be a favorable environment for these elements.

The Carboniferous rocks along Red Indian Lake contain disseminated carbonaceous material and granitic detritus from the Topsails Granite. Despite their red oxidation color, the presence of favorable source rocks and their depositional environment indicate a favorable area for uranium mineralization. However, no anomalous readings were found by handheld scintillometer.

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