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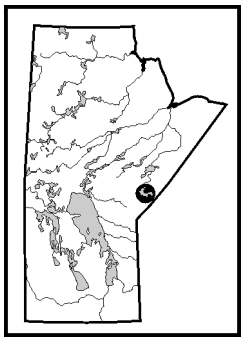
GS-21 New insights into supracrustal assemblages and regional correlations for the Island Lake greenstone belt, northwestern Superior Province, Manitoba (parts of NTS 53E15 and 16)

by J. Parks[1], S. Lin[1], M.T. Corkery and D.W. Davis[2]



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Summary

The Island Lake greenstone belt consists of the older, predominantly volcanic rocks of the Hayes River Group and the younger sedimentary rocks of the Island Lake Group, as well as various plutons. At least three episodes of volcanism are recorded in the Hayes River Group, at ca. 2.89 Ga, ca. 2.85 Ga and 2.74 Ga. New field data have led to a new interpretation of the structure of the ca. 2.85 Ga supracrustal rocks in the belt. New geochronological data confirm shear-zone activity at ca. 2700 Ma along one of the largest and most continuous structures in the belt, the Savage Island Shear Zone. Similarity to the ages of volcanism observed in the Red Lake greenstone belt may indicate that contemporaneous processes were occurring on both the north and south margins of the North Caribou Terrane. These similar ages may have potentially important economic implications for the Island Lake greenstone belt, since the Red Lake greenstone belt hosts one of the world's richest gold camps.

Introduction

The Island Lake greenstone belt is one of the best exposed belts in the northwestern Superior Province and records close to 200 m.y. of sedimentation, plutonism, volcanism and deformation. The aim of this study is to better understand the nature of the crust and the mechanisms of greenstone-belt assembly in this area, as well as their importance with respect to the tectonic evolution of the surrounding Archean terranes in the northwestern Superior Province.

A three-week field program was conducted this summer to follow up on two nine-week field programs conducted in the summers of 2001 and 2002. This summer, particular attention was paid to testing stratigraphic and structural interpretations made in Parks et al. (2002), and to collect further samples for geochronological analysis. This paper presents the results from this field work, as well as new geochronological data and proposed regional correlations.

General geology

The Island Lake greenstone belt, part of the Island Lake Terrane, is located in the northwestern Superior Province. It is flanked to the south by the ca. 3.0 Ga crust of the North Caribou Terrane and to the north by the <2.86 Ga Munro Lake Terrane (Thurston et al., 1991). The rocks in the belt have traditionally been divided into the volcanic and volcanogenic sedimentary rocks of the Hayes River Group and the unconformably overlying sedimentary rocks of the Island Lake Group (Fig. GS-21-1; Weber et al., 1982). The Island Lake Group is a 'Timiskaming'-type sedimentary group that is commonly found in other Archean terranes of similar age around the world. This group consists of polymictic conglomerate, sandstone and turbidite sequences. Its age of deposition is bracketed between ca. 2712 Ma (the age of the youngest detrital zircon) and ca. 2699 Ma (the age of a crosscutting intrusion; Turek et al., 1986). The greenstone belt is intruded by various plutons that range in age from ca. 2894 Ma (Parks et al., 2001) to ca. 2699 Ma (Turek et al., 1986).

New insights into supracrustal assemblages in the Hayes River Group

The Hayes River Group can be subdivided into as many as five different supracrustal assemblages (Lin et al., 1998; Parks et al., 2001), termed tectonostratigraphic panels in Parks et al. (2002). These assemblages are the Jubilee Panel, Loonfoot Panel, Whiteway Panel, York Panel and Pipe Point Panel. At least three ages of volcanism are recorded in these panels: ca. 2.89 Ga (Whiteway Panel), ca. 2.85 Ga (Jubilee Panel) and ca. 2.74 Ga (Loonfoot Panel). The age, geochemical nature, stratigraphy and structure of these assemblages were discussed by Parks et al. (2002); the age of the Pipe Point Panel and the structure and stratigraphy of the Jubilee Panel are further refined here.

[1] Department of Earth Sciences, University of Waterloo, Waterloo, Ontario N2L 3G1

[2] Royal Ontario Museum, 100 Queens Park, Toronto, Ontario M5S 2C6

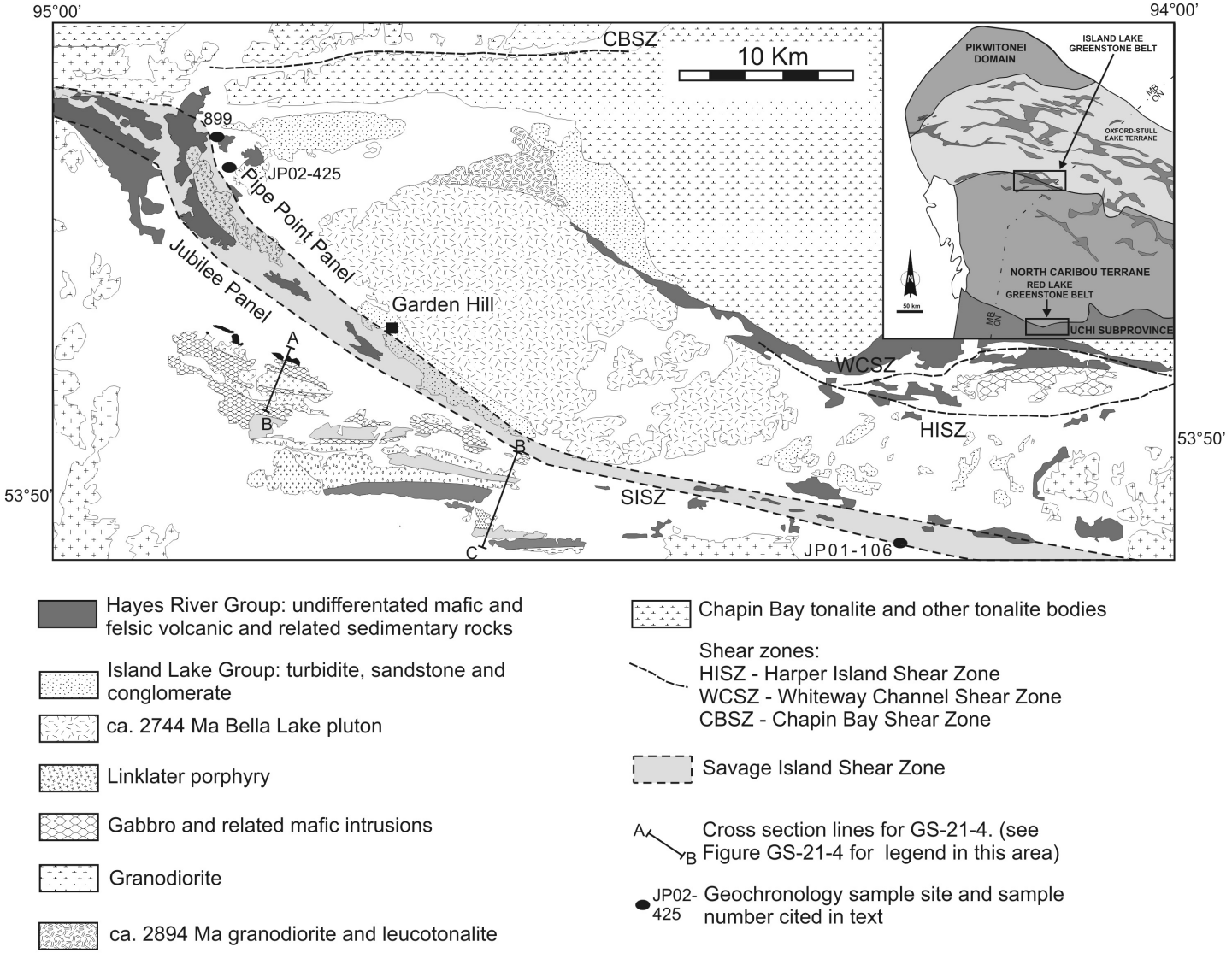

Figure GS-21-1: Simplified geology of the Island Lake greenstone belt (modified from Parks et al., 2002 and references therein); inset map (modified after Thurston et al., 1991; Stott, 1997; Skulski et al., 2000; Parmenter, 2002) shows the location of the terranes in the northwestern Superior Province; Island Lake and Red Lake areas are indicated by boxes; legend for Jubilee panel area marked with cross-section lines shown in Figure GS-21-4.

Pipe Point Panel

The Pipe Point Panel was previously described as possibly the youngest supracrustal assemblage in the Hayes River Group. This interpretation was based on a U-Pb zircon age of 2730 Ma (sample 899, Parks et al., 2001) from a quartz porphyry. Nevertheless, the origin and contact relationships of this porphyry with the surrounding supracrustal rocks were unclear. To better constrain the age of this assemblage, a rock that is clearly a felsic tuff (Fig. GS-21-2) was dated and yielded a U-Pb zircon age of ca. 2854 Ma (sample 425, J. Parks, unpublished data, 2003). This age is essentially identical to the age of the supracrustal rocks of the Jubilee Panel, and suggests that these two assemblages may be related. Further geochemical work and structural reconstructions are planned, to determine whether these panels are related or this felsic tuff is just a xenolith of Jubilee Panel rocks that has been included in this panel.

Jubilee Panel

The stratigraphy and structure of the most extensive and continuous panel, the Jubilee Panel, was discussed in detail and a schematic cross-section and fold geometry were proposed by Parks et al. (2002). A main aim of field work this summer was to test this interpretation and further refine the stratigraphy and structure of this panel. In particular, attention was paid to contacts of the two thrust sheets that were proposed to be juxtaposed between the anticline and syncline structures in this panel.

A thrust contact was previously proposed between the northern felsic unit and the middle basaltic unit. Detailed mapping this summer did not confirm the presence of a deformation zone along this contact. Primary features are well preserved and the degree of deformation observed in outcrop in this area is weak. The contact between these two units is here interpreted to be a primary stratigraphic contact. The mafic rocks that were initially described as a separate thrust package (middle basaltic unit from Fig. GS-25-4 in Parks et al., 2002) in fact belong to the northern basaltic unit and have been repeated due to folding in this area. Further geochemical analyses are planned to confirm whether this package of mafic rocks has a similar affinity to those in the northern basaltic suite.

A thrust was also proposed along the contact of the middle basaltic unit (now the northern basaltic unit, as redefined above) and the middle sedimentary unit. Detailed mapping this summer confirmed the presence of a deformation zone along this contact. The strain along this contact appears to have been mainly accommodated in the northern basaltic unit, where primary structures have been completely obliterated. A gossan zone and sulphide alteration mark the contact in the northern basaltic unit. Foliation in the deformation zone strikes west and dips vertically to steeply north. Asymmetric boudinaged quartz veins, S/C fabrics and drag folds indicate a sinistral strike-slip movement and north-over-south dip-slip movement along this deformation zone (Fig. GS-21-3).

The fold geometry and stratigraphy resulting from these new field observations are presented here in a schematic cross-section (Fig. GS-21-4).

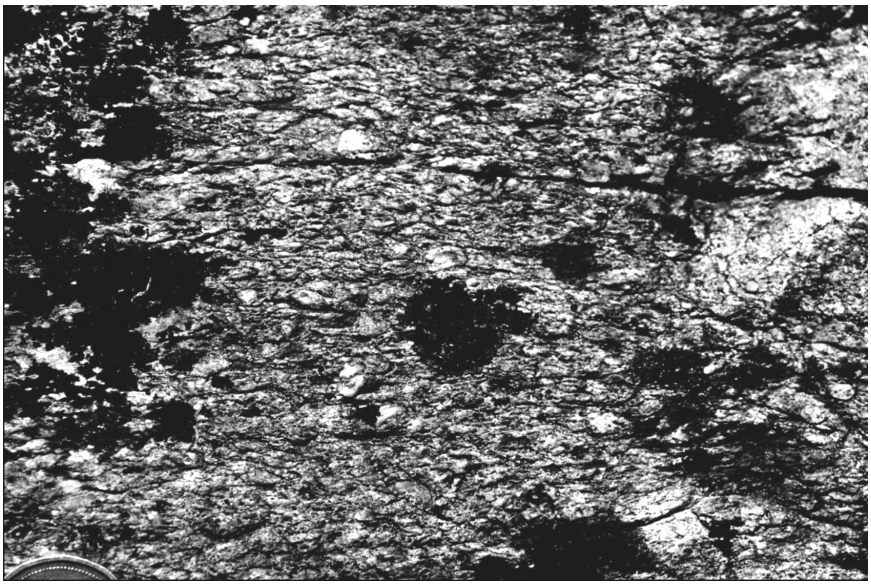

Figure GS-21-2: Sample JP02-425, a felsic tuff with well-preserved volcanic features (e.g., volcanogenic clasts); top of penny (for scale) can be seen in bottom left corner.

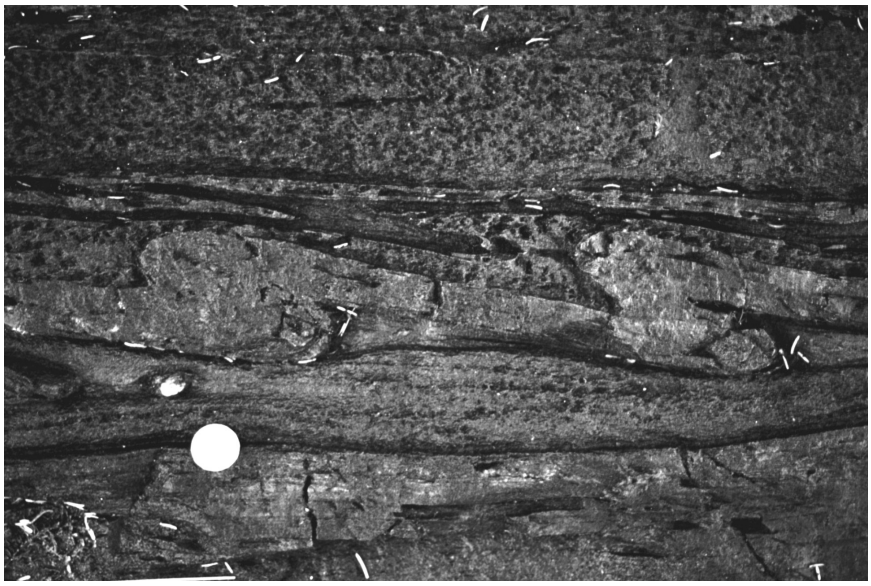

Figure GS-21-3: Drag folds in northern basaltic suite, indicating a sinistral sense of shear.

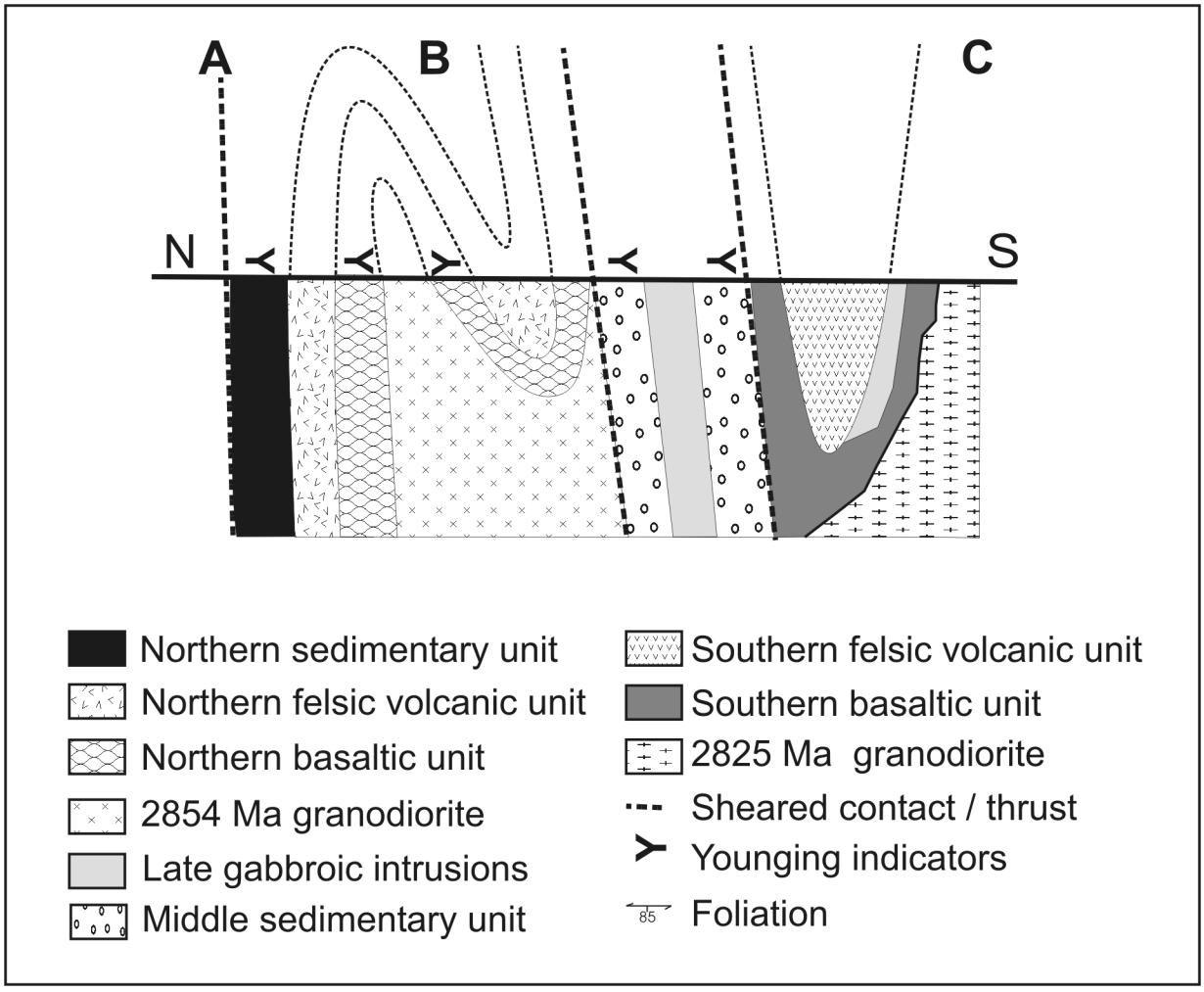

Figure GS-21-4: Composite schematic cross-section showing the geometry of the structure in the Jubilee Panel. Cross-section lines are indicated on Figure GS-21-1.

Timing of deformation

The Island Lake greenstone belt has undergone at least two generations of deformation. The first generation produced isoclinal folding of the supracrustal Jubilee Panel, whereas later generation(s) produced at least four spatially distinct shear zones, the largest and most continuous of which is the Savage Island Shear Zone. These shear zones are described in more detail in Lin et al. (1998) and Parks et al. (2001). Placing geochronological constraints on these deformation events in this belt has been a major aim of this project. Two ages of deformation have been previously reported, an earlier event responsible for a fabric development at ca. 2724 Ma and a younger event at ca. 2700 Ma that produced the fabric observed in the Harper Island Shear Zone (Parks et al., 2001, 2002). More recently, a weakly boudinaged late synkinematic dike, lacking any internal foliation and cutting the shear-zone fabric, was sampled from the Savage Island Shear Zone. This quartz-feldspar porphyry dike yielded a U-Pb zircon age of ca. 2700 Ma (sample 106, J. Parks, unpublished data, 2003; Fig. GS-21-5). This age agrees with the previously reported age of shear-zone deformation in the Island Lake greenstone belt, confirming shear-zone activity at ca. 2700 Ma.

Regional correlations and economic implications

At least three ages of volcanism are observed in the Island Lake greenstone belt: ca. 2.89 Ga, ca. 2.85 Ga and ca. 2.74 Ga. Some of these ages of volcanism are recorded in other belts in the northwestern Superior Province. There is a lack of evidence of ca. 2.89 Ga volcanism in terranes north of Island Lake; however, it is a common age of volcanism in belts in the North Caribou Terrane to the south, such as in the Hornby Lake belt (Corfu et al., 1998). Circa 2.85 Ga volcanism is also recorded in many belts of the North Caribou Terrane to the south, such as the Favourable Lake and North Caribou belts (Corfu et al., 1998). To the north, in the Oxford Lake–Stull Lake Terrane, slightly younger ages of volcanism are observed in the Knee Lake belt at 2.83 Ga (Corkery et al., 2000), as well as in the Stull Lake–Edmund Lake belt (Skulski et al., 2000). There is a lack of evidence of ca 2.74 Ga volcanism in terranes both to the north of the Island Lake greenstone belt and to the south in the North Caribou Terrane.

Of particular interest is the presence in the Red Lake greenstone belt of all three of the volcanic episodes observed in the Island Lake greenstone belt. The Red Lake greenstone belt is located in the Uchi Subprovince of the Superior Province, south of the North Caribou Terrane (Fig. GS-21-1). It is interpreted to have been built on the southern margin of the volcanoplutonic substrate of the North Caribou Terrane (Sanborn-Barrie et al., 2001). Circa 2.9 Ga volcanism occurs in the Bruce Channel assemblage, ca. 2.85 Ga volcanism occurs in the Trout Bay assemblage and ca. 2.74 Ga volcanism occurs in the McNeely sequence of the Confederation assemblage (Sanborn-Barrie et al., 2001). The presence of all three ages of volcanism in both belts may indicate that contemporaneous processes were occurring on both the northern and southern margins of the North Caribou Terrane. Whether these contemporaneous events can be petrogenetically linked is currently unknown. If such links can be made, this similarity could have important implications for the tectonic evolution of the northwestern Superior Province, as well as economic implications for the Island Lake greenstone belt, since the Red Lake greenstone belt hosts one of the world's richest gold camps.

Figure GS-21-5: Sample JP02-106, a late synkinematic dike in contact with deformed mafic rocks (contact indicated by dashed line); the dike crosscuts the fabric developed in the Savage Island Shear Zone (fabric indicated by solid line).

Conclusions and future work

New data from the past year's studies have led to 1) a new interpretation of the structure and stratigraphy of the ca. 2.85 Ga supracrustal rocks in the Island Lake greenstone belt in the Jubilee Panel; and 2) confirmation of shear-zone activity at ca. 2700 Ma along one of the largest and most continuous

structures in the belt, the Savage Island Shear Zone. As well, a similarity in ages of volcanism recorded in the Island lake greenstone belt and the Red Lake greenstone belt may suggest that contemporaneous processes were occurring on both the northern and southern margins of the North Caribou Terrane, which may have important economic implications for gold potential in the Island Lake greenstone belt.

Continuing studies in the Island Lake greenstone belt will attempt to better understand the nature of crustal development and the mechanism of greenstone belt assembly. Further geochemical and structural studies will test the stratigraphic and structural relationship presented above. Samarium-neodymium isotopic work will look at the degree and variations of crustal contamination in the belt. As well, to better understand the depositional evolution of the Island Lake Group, U-Pb detrital zircon analysis will be used to study the age of provenance of the sedimentary rocks and how this changes up-section within the Island Lake Group. This will help in understanding the tectonic setting for the deposition of this group, as well as other 'Timiskaming'-type sedimentary groups found in other Archean cratons.

Acknowledgments

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