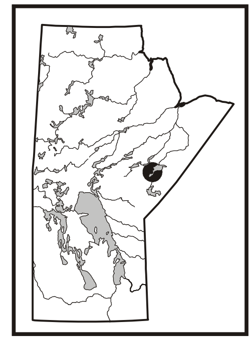
GS-18 **GEOLOGICAL INVESTIGATIONS IN THE GODS LAKE NARROWS AREA (PARTS OF NTS 53L/9 AND 53L/10)**



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SUMMARY

The Knee Lake Belt mapping program was expanded to the southeast into the Gods Lake Narrows area in 1999. This multidisciplinary stratigraphic, structural, geochronologic and geochemical program is being conducted to better constrain the setting of base- and precious-metal mineral occurrences and deposits in the area. Results of the 1999 mapping include: 1) identification a regional angular unconformity between the Hayes River Group metavolcanic rocks and the Oxford Lake sedimentary subgroup; 2) the boundary between the sedimentary subgroup and volcanic subgroups of the Oxford Lake Group is a shear zone formed during G_1 deformation; 3) the G_1 shear zone is folded as a result deformation associated with the southern belt bounding G_2 shear zone, the Gods Lake Narrows shear zone; 4) a septa of the Munro Lake greenstone belt is separated from the Knee Lake Belt by both an older gneiss belt and a major shear zone, the Gods Lake Narrows shear zone.

INTRODUCTION

A primary goal of Manitoba's Northern Superior projects is to better understand the volcanic, structural and tectonic evolution of greenstone belts in the Manitoba portion of Sachigo subprovince/Gods Lake domain. Central to this objective is an understanding of the largest contiguous greenstone belt in the Sachigo, the Knee Lake Belt (Fig. GS-18-1). This investigation represents continuation of the multidisciplinary stratigraphic, geochemical, structural and geochronological studies of this belt (Syme et al., 1997, 1998) being conducted as part of the Western Superior NATMAP Project.

Mapping at a scale of 1:20 000 in the Gods Lake Narrows area in 1999 extends the study of the Knee Lake Belt to the southeast (Fig. GS-18-2). This area provides both along-strike continuity and access to excellent exposure of the southern boundary of the belt. Existing 1:50 000 maps (Gilbert, 1985; Barry, 1961) formed an excellent base on which to integrate new observations.

Previous work

Work in the Gods Lake area prior to 1970 was conducted by Wright (1931), Dix (1947), and Barry (1961). The Gods Narrows map sheet by Barry (1961) was a particularly useful geological base for our investigations in the central part of Gods Lake.

The Gods Lake area was remapped in the early 1970's as part of the 'Greenstone Project' (bibliography in Gilbert, 1985). The Gods Lake Narrows area is covered by two 2-colour 1:50 000 maps: GR83-1-12, -13, and one black and white preliminary map (1973H-12). A review of the exploration history of the area up to 1977 is contained in Southard (1977).

Regional Setting

Supracrustal rocks in the Knee Lake Belt have been assigned previously to two principal stratigraphic entities, the Hayes River Group (HRG) and Oxford Lake Group (OLG) (Gilbert, 1985 and references therein). These Groups are the principal focus of our recent work in that they have more potential to host gold and base metal deposits than the voluminous granitoid terrains in the Superior Province.

The HRG (ca. 2830 Ma at Knee Lake, D. Davis, pers. comm. 1986) is a predominantly volcanic sequence dominated by pillowed basalt and related gabbro, minor intermediate to felsic volcanic rocks and minor volcanogenic sedimentary rocks. In the southeastern Gods Lake area both the base and the top of the HRG have been intruded by tonalitic to granitic plutons and related gneisses of the Bayly Lake Complex (2783-2730 Ma, D. Davis, pers. comm. 1986).

The OLG (ca. 2706 Ma at Oxford Lake, D. Davis, pers. comm. 1986) is an up to 12 km thick largely sedimentary succession that lies unconformably on HRG volcanic rocks at Gods Lake (Gilbert, 1985). It consists of a lower, dominantly 'volcanic' subgroup of limited extent and an overlying, more extensive sedimentary subgroup. The OLG extends along the southern margin of the belt from Oxford Lake to Magill Lake (40 km; Gilbert, 1985; Manitoba Energy and Mines, 1987) and discontinuously to the Gods Lake Narrows area. Volcanic rocks in the lower subgroup are shoshonitic to calc-alkalic in character (Hubregtse, 1976; Brooks et al., 1982; Gilbert, 1985). They include fragmental and flow rocks but are dominated by conglomeratic epilastic rocks (Syme et al., 1997). The sedimentary subgroup is dominated by units deposited in a subareal to locally shallow marine environment.

GODS LAKE NARROWS

Northeast of Gods Lake Narrows HRG mafic volcanic rocks comprise a homoclinal, northwest-facing, 2 to 3 km thick sequence (Fig. GS-18-2). It is truncated to the south at an angular unconformity by east-trending and south-facing Oxford Lake sedimentary subgroup conglomerate. To the northwest and southeast HRG rocks are intruded by granite of the Bayly Lake Complex.

The OLG, south of the unconformity, is contained in a southwest-facing, southeast-trending belt up to 5 km wide (Fig. GS-18-2). They sedimentary subgroup directly overlying the HRG forms a 1 km thick, largely subareal succession, and is in fault contact to the south with a second south-facing sequence dominated by a submarine succession of fine-grained sedimentary rocks of probable Oxford Lake volcanic subgroup affinity.

The southern boundary of the Knee Lake Belt is marked by a major 1-1.5 km wide mylonite through Gods Lake Narrows. South of the structure a 10 km thick older felsic gneiss complex (U-Pb age of 2883 Ma, Davis pers. comm., 1986), separates the Knee Lake Belt from several thin slivers of supracrustal rocks that form the eastern extension of the Munro Lake Belt.

Hayes River Group

Primary structures and textures are well preserved in the upper portions of the basalt-dominated HRG at Gods Lake Narrows. The amount of strain recorded in the flows increases to the south and is exhibited as a progressive increase in a penetrative, variably spaced, east-trending fracture cleavage and associated minor faults. Major faults and shear zones within the section generally strike easterly or are conformable with northeast-trending stratigraphy. The thickest intact sequence is 3 km thick (Fig. GS-18-2).

HRG rocks at Gods Lake Narrows are dominated by massive and pillowed aphyric to weakly plagioclase phyric flows with subordinate amoeboid pillow flow top breccia. These flows have a characteristic medium green weathering. Pillows have thin selvages and display thick interpillow hyaloclastite or interpillow chert. They typically have vesicular margins and commonly contain 1 by 2 to 5 mm radial pipe vesicles. Numerous basalt-associated gabbro sills and dykes intrude the sequence and range from centimetre scale to greater than 100 m thick. Some of these gabbro sills may be thick, ponded basalt flows.

Oxford Lake Group

At Gods Lake Narrows both volcanic and sedimentary subgroups of the OLG are exposed. The volcanic subgroup forms a 3 to 4 km thick, fault-bounded panel (Fig. GS-18-2). Although most rocks in this panel are highly strained, primary structures and textures (including graded

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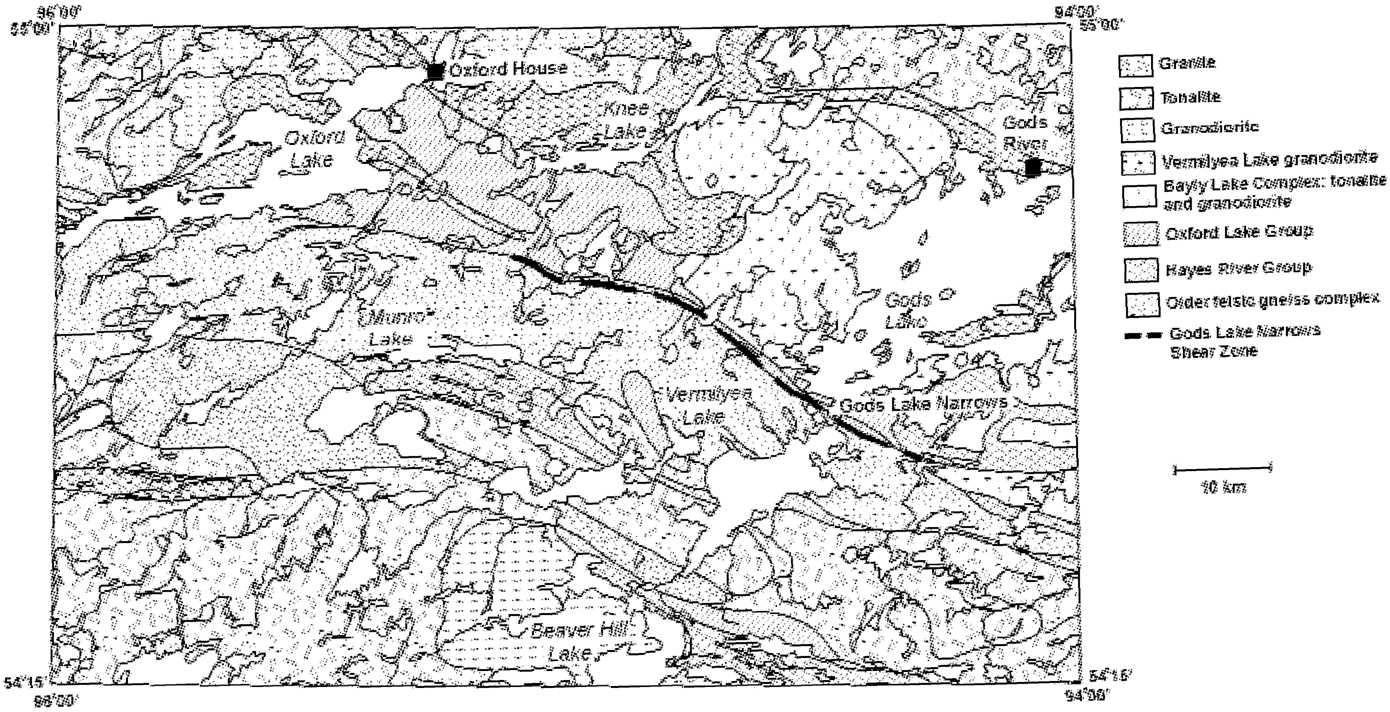

Figure GS-18-1: *Regional geologic setting and major subdivisions in the Gods Lake region.*

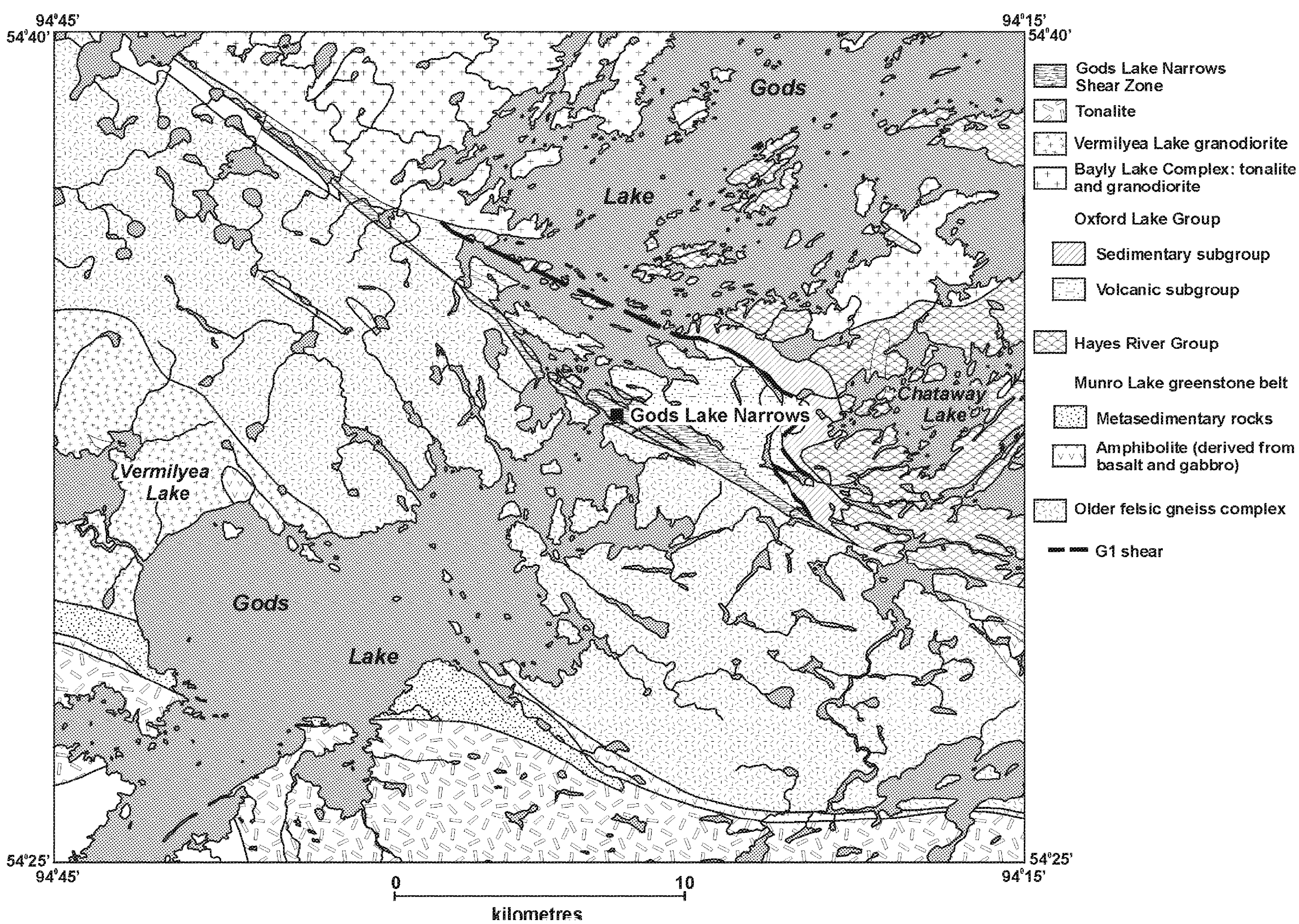

Figure GS-18-2: *General geology of south and central Gods Lake, modified from Manitoba Energy and Mines (1987).*

bedding) in the sedimentary rocks indicate this to be a southward younging sequence.

Light grey-weathering "greywacke" siltstone, sandstone and pebbly sandstone form the bulk of the volcanic subgroup. Coarser grained, pebbly sections include sporadic interbeds of greywacke-matrix, last-supported polymictic conglomerate. Dark green-grey to black- weathering, amphibole-rich mafic sediments that include siltstones and basalt- clast-rich conglomerate, occur sporadically throughout the section, but are most abundant at its base. Interbeds of sandstone and pebbly sandstone occur throughout the section. Chert-magnetite iron formation, ironstone and argillite are common in the siltstone sequences. Locally well preserved primary sedimentary structures (e.g., graded bedding, flame and rippups) indicate deposition in a subaqueous environment.

The OLG sedimentary subgroup (Fig. GS-18-2) is a simple, 1-1.5 km thick continuous sequence of well preserved polymictic conglomerate. A section mapped through the eastern end of the unit revealed no indication of either fining or coarsening upward.

Conglomerate is medium- to thickly-bedded, with beds generally ranging from 0.5 to 3 m, with thickest beds up to 7 m thick. Clasts are highly variable in size (pebble to small boulders), well rounded, and display a well developed sphericity. They do not show particularly good sorting but do show organization by variations in average clast size from bed to bed. Clast populations are highly variable with respect to rock type and include a wide variety of supracrustal rocks, intrusive rocks and metamorphic rocks. Large scale bedforms, although rare, include 20-80 cm sand, pebble or cobble dominated forsets within thick conglomerate beds. The sandy matrix of the conglomerate is a light grey-weathering, medium- to coarse-grained, feldspar-rich, quartz-poor greywacke. Sandstone lenses with the same composition as the matrix occur as individual beds or as bed sets sporadically throughout the section.

Beds in the feldspathic greywacke and pebble- cobble- sandstones range from about 10 cm to 2.5 m thick. Crossbedding in the sandstone is either planer as bedding plane parallel or low angle cross beds. Sandstone beds display scour around clasts of underlying conglomerate beds, providing good top indicators. Locally the sandstones contain a few per cent pebbles, either as a basal lag, or scattered along foreset beds in some crossbeds. Interbeds of pebbly sandstone are common.

MUNRO LAKE BELT

To the south of the older felsic gneiss complex a highly deformed and metamorphosed extension of the Munro Lake greenstone belt is exposed (Fig. GS-18-1). The belt bifurcates toward the west around the Vermilyea Lake granodiorite, forming two salients that diverge northwestward and terminate in the granitoid terrane (Martin, 1992). On Gods Lake, basaltic amphibolite forms the north and south margins of the Munro Lake Belt metasedimentary rocks form a crescent shaped body in the core of the belt (Fig. GS-18-1).

The amphibolite is generally fine-grained dark green-grey to black, with a well developed foliation and compositional lamination. In the Raven Islands area highly attenuated pillow basalt is transitional into fine grained laminated amphibolite. To the south, on the east shore of Gods Lake, highly deformed layered gabbro with bands of magnetite and ilmenite form layers within the fine-grained amphibolite.

Quartz-rich greywacke and subordinate siltstone dominate the metasedimentary succession. Bedding varies from 5-50 cm thick, with local graded bedding and rare rip-ups and flame structures. At amphibolite grade the metagreywacke is grey-brown to grey, medium-grained, quartzofeldspathic, biotite rich schist with muscovite and garnet and, in more pelitic beds, 2-10 cm andalusite porphyroblasts.

STRUCTURE

Deformation in the OLG is much stronger than that in the HRG. Deformation in the latter is mainly concentrated in localized shear zones, and many parts of the group are only weakly deformed. In contrast, rocks of the OLG are generally very strongly deformed. A similar pattern in deformation distribution has been described for the Knee Lake area (Syme et al., 1997).

Two major generations (G_1 and G_2) of shear zone deformation that affects the OLG have been distinguished. The G_1 deformation is associated with a major shear zone centered between the polymictic conglomerate to the north and the rest of the OLG to the south. Extremely strong deformation occurred in the shear zone where mylonite is well developed (Fig. GS-18-3). Mylonitic foliations (S-surfaces (S_1) and C-surfaces (C_1)) dips steeply to the south. Both the stretching lineations on S-surfaces (Ls_1) and the striations on C-surfaces (Lc_1; Lin and Williams, 1992) plunge steeply to down dip. Preliminary observations indicate south-over-north thrust sense of shear, the reliability of which will be tested through detailed microscopic study of oriented samples of mylonite collected from the shear zone.

Spatially associated with the centre of the shear zone is a tonalite sheet. The sheet is from a half metre to a few tens of metres wide and can be traced for over 10 km, along the entire length of the G_1 shear zone. We suspect that the intrusion of the tonalite sheet was controlled by the shear zone based on the close spatial association. A geochronological sample of the tonalite was collected and will be dated using the U-Pb method by D.W. Davis.

The G_1 shear zone is traced from the west end of the map area to near the Chataway Lake to the east, where it is folded as the result of deformation associated with the G_2 Gods Lake Narrows shear zone (GLNSZ). The GLNSZ is part of a regional shear zone that occurs at the southern edge of the Knee Lake. It can be traced at least 20 km further to the east (Manitoba Energy and Mines, 1987).

In the Gods Lake Narrows area, the mylonite zone in the GLNSZ is over 500 m wide. Near the northern edge of the GLNSZ, the G_1 foliation described above is folded with axial plane parallel to the strike of the G_2 shear zone (Fig. GS-18-4). Within the GLNSZ shear zone, the G_1 foliations are fully transposed into new mylonitic foliations (S_2 and C_2). Sheath folds are observed at several localities. The S_2 and C_2 also dip steeply. Striations on C-surfaces vary continuously from subhorizontal to

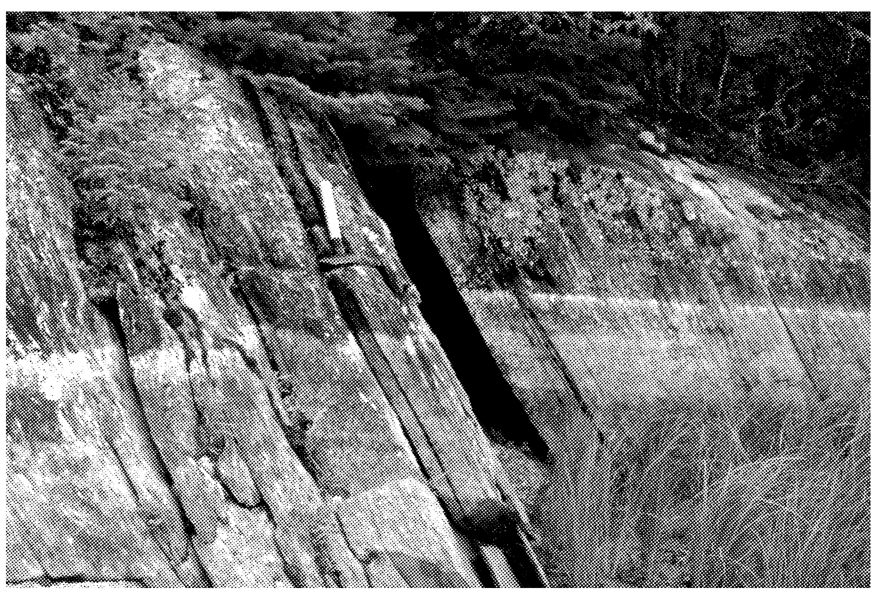

Figure GS-18-3: Deformed rocks in the G_1 shear zone. The hammer marks the contact between the deformed polymictic conglomerate of the OLG (left) and the deformed tonalite sheet in the centre of the shear zone (right).

Figure GS-18-4: G_1 mylonitic foliation folded as a result of deformation associated with the Gods Lake Narrows shear zone. The photo is taken from the hinge area of a macroscopic fold in the G_1 shear zone to the west of Chataway Lake.

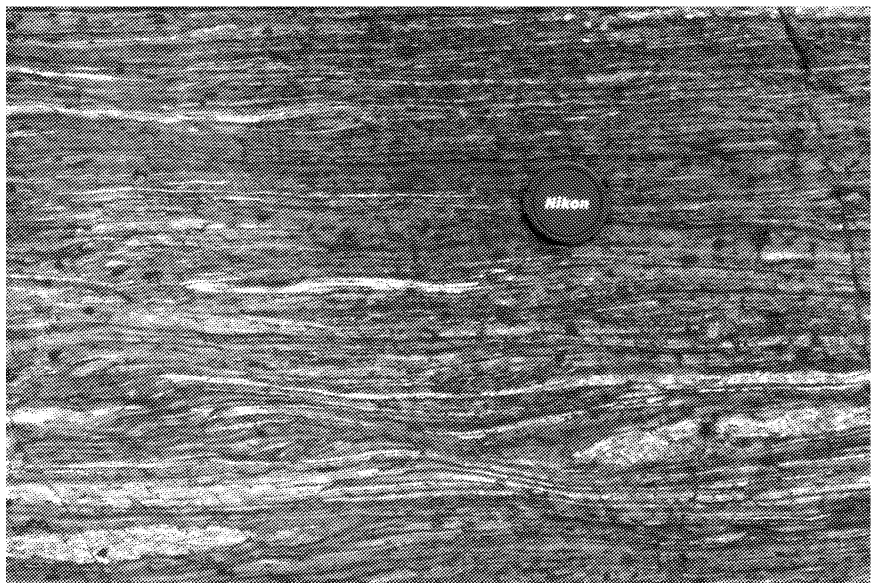

Figure GS-18-5: Deformed conglomerate in the Gods Lake Narrows shear zone. Shear bands in the centre of the photo indicates dextral shear. Horizontal outcrop.

moderately plunging, providing a good example of slip partitioning within a single shear zone (Lin et al., 1999 and references therein). Well-developed shear sense indicators, such as S-C structures and drag folds, indicate dominant dextral transcurrent shear with a south-over-north dip-slip component (Fig. GS-18-5).

Spatially associated with the GLNSZ are numerous tonalitic dykes. These dykes are a few centimetres to a few tens of metres wide, are subparallel to the S_2 foliation, and many of them can be traced across the map area. Detailed observation shows that they cut the S_2 foliation at low angle but also experienced varying degrees of G_2 deformation, indicating that the dykes intruded during the G_2 shear zone deformation. A sample from one of the dykes will be dated using the U-Pb method by D.W. Davis.

At this stage of study, it is not clear whether the G_1 and G_2 deformation represent two stages of a single episode of deformation or two separate episodes of deformation. This is a focus of continuing investigation.

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