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ZONE OF ANOMALOUS MANTLE

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The most striking characteristic of both the Siberian and Slave diamond fields is their linear distribution. The concept of the "Corridor of Hope" was introduced by Ed Schiller (2003), soon after the discovery of the Lac de Gras Diamond Field in 1991, to refer to a northwest trend that appears to have controlled the emplacement of the most significantly diamondiferous kimberlites of the Slave craton. Darnley Bay recognized that the kimberlites on the Parry peninsula, northwest of the Slave craton, lay in a "Diamond Corridor" that was probably a displaced northern extension of the "Corridor of Hope". The well established linear trend of the Siberian diamondiferous kimberlite fields was described by Kaminsky et al. in 1995 as a "Zone of Anomalous Mantle".

The economic importance of the western North American and Siberian corridors/zones is recognized. The "Diamond Corridor" or northern extension of the "Corridor of Hope" is examined on the basis of recent exploration. An attempt is made to determine from the literature what these corridors/zones have in common and how they were formed. A model put forward by Helmstaedt (2009) to explain the distribution of the diamondiferous kimberlites of the "Corridor of Hope" is proposed for the western North American and Siberian corridors and their extensions.

"Corridor of Hope"

The "Corridor of Hope" stretches 470 kilometers from Coronation Gulf to Great Slave Lake and includes the most significantly diamondiferous kimberlites of the Slave craton (figure 1).The Corridor lies along the core of the MacKenzie Dyke Swarm and appears to be cut off by the Great Slave Shear zone in the south and a similar shear zone through Coronation Gulf in the north. Discoveries constituting the West Slave Diamond Field lie outside this Corridor (figure 1). From an exploration point of view it appears to have been better to be inside the "Corridor of Hope" than outside it.

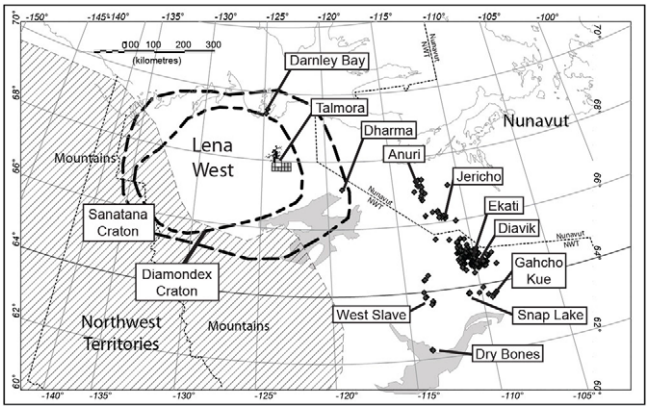

FIGURE 1: Cratons adapted from Diamondex & Sanatana websites and known kimberlite fields (diamonds) in relation to Talmora property (rectangles)

"Diamond Corridor" and Lena West

Darnley Bay (2004) noted the relation of kimberlites to diabase dykes on the Parry Peninsula and recognized the trend of the dykes as a favourable "Diamond Corridor" and the possible northern extension of the "Corridor of Hope".

A large area west of the "Diamond Corridor" was taken up by Diamondex, De Beers and Sanatana and was named Lena West because of its similarity to the diamond fields in the area of the Lena River of Siberia. Numerous kimberlite indicator minerals (KIMs) with good diamond association chemistry and an unprecedented 15 diamonds were found widely spread across Lena West. It seemed that the "Diamond Corridor" may be proved to be no corridor at all.

Slice of the Corridor

In 2007 Sanatana discovered the very diamondiferous Dharma kimberlite pipe coincident with a swarm of diabase dykes in the northeast corner of Great Bear Lake. Talmora recognized that Dharma may be in a slice of the "Diamond Corridor" between parallel shear zones as shown in figure 2.

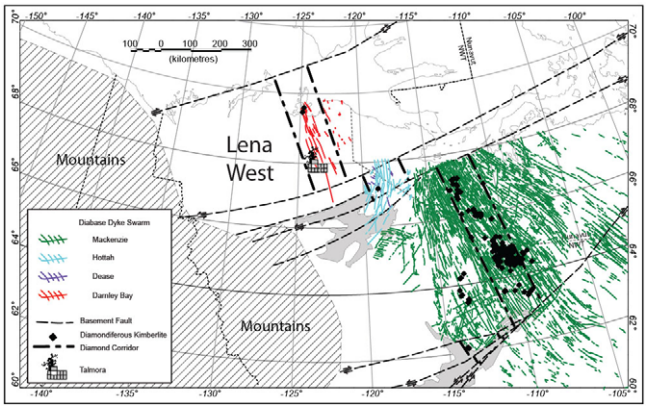

FIGURE 2: Diamondiferous kimberlites (diamonds) with respect to diabase dyke swarms and probable shear zones that displaced the northern extension of the Slave Craton 350 km to the west.

Corridor the Source of the Lena West KIMs

Diamondex (Agashev, 2008) proved that many if not all their KIMs, and presumably diamonds, and probably those of others, were derived from the base of the Cretaceous basin that covers most of Lena West. From the same sediments they also obtained a kimberlitic zircon with an age of 164 $\pm$ 6 Ma and 3 Archean zircons that indicate that the sediments were derived from the east or from the direction of the "Diamond Corridor" and from outside the Cretaceous basin.

The large areas sampled by Diamondex and Sanatana show identical KIM chemistry as if they were from a single source. The KIM chemistry does not match that of Darnley Bay. Dharma Ilmenites have a restricted range of compositions, pyropes include some high Cr compositions and there are fewer high Cr spinels. The Talmora property appears to have been subjected to a period of laterite formation which has destroyed many of the silicate KIMs. However, Talmora's ilmenites, spinels and the few eclogitic garnets and chrome diopsides are identical to the majority of Lena West KIMs. Talmora has no G-10s among the 18 much altered pyrope grains recovered which is hardly enough to expect a G-10. There is also evidence of preferential destruction of G-10 garnets in the region's tills compared to those in related pipes (Doyle, et al. 2008).

With renewed confidence in the "Diamond Corridor" as a favourable zone for diamond exploration it is appropriate to review its characteristics.

Lena East (Siberia) compared to Lena West (NWT)

The most striking characteristic of both the Siberian and Slave diamond fields is their linear distribution. Diamonds have a wide range of ages. However, diamonds from peridotites generally have a mid- to late Archean age (3.5 – 2.5 Ga) while those from eclogites have a late Archean to late Proterozoic age. The eclogitic diamonds are generally believed to be related to subduction and accretion on an Archean craton. The N American and Siberian linear corridors must have been in place by late Archean time. Rosen et al (2002) presented a reconstruction of the Proterozoic Supercontinent for 2.0-0.8 Ga ago. Modifications made to this reconstruction so that the Siberian linear lines up with the Slave "Corridor of Hope" are shown in figure 3.

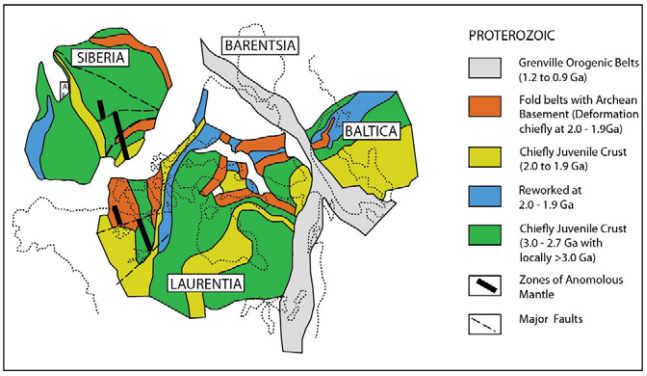

FIGURE 3: Reconstruction of the Proterozoic for 2.0-1.9 and 0.8 Ga ago (after Rosen et al 2002). The Lena East and Lena West zones of anomalous mantle have been added and the Siberian craton moved so that the zones line up. The geology in the area of Lena West has been modified to take account of the newly discovered kimberlites in Canada.

Characteristics of Lena East (Siberia)

The Siberian diamond fields have a linear distribution over 1000 km with one major offset on the Kotuykan shear zone (Mirny of figure 4) and perhaps a lesser offset north of Muna on the Billyakh shear zone. The southern end of this linear includes the more important economic kimberlites.

Griffin et al (1999) studied mantle xenoliths and xenocrysts along the Siberian linear corridor Hartsburgite makes up a significant part of the lower mantle beneath the Archean terrane to the south but is missing beneath the Proterozoic terrane to the north. The lithosphere is 190-240 km thick with a low geotherm of 35 mW/m2 in the south which thins to 125 km in the north with higher geotherm of 40 mW/m2. This in effect puts the graphite/diamond boundary into the asthenosphere. The lithospheric mantle appears to have been thinned and possibly reworked during the Proterozoic collision from the north.

Kaminsky et al. (1995) describe the diamond fields of Siberia as a zone of contiguous long-lived deep-seated major faults, controlling the intrusion of mantle magmatism". They call it a "Zone of Anomalous Mantle" (ZAM) that does not correlate well with geological structure but does correlate with some geophysical lineaments. It runs parallel to a 100 km wide

regional gravity high with some of its individual fields in the gravity high but most along the edge of the gravity high.

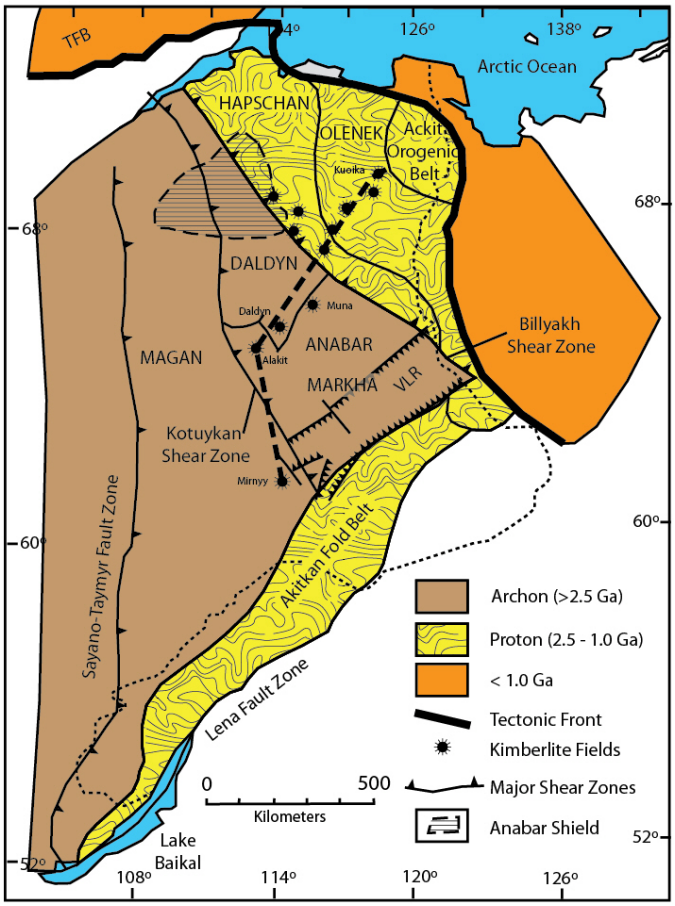

FIGURE 4: Terrane map of the eastern Siberian platform, from Djomani et al (2003) and after Rosen et al (1994), showing the location of the kimberlite fields and major boundaries. (VLR: Vilyui rift, TFB: Taymyr fold belt.)

The Siberian diamond fields are located in morphostructures which are surface reflections of deep seated structures. They are circular fractures generally less than 60 km but up to 100 km diameter that are localized on deep-seated faults and within which are radial fractures and smaller circular fractures. Intersections of the various fractures provide the channels for emplacement of kimberlite. (figure5)

Characteristics of Lena West (Canada)

What the Slave "Corridor of Hope", the Darnley Bay "Diamond Corridor" and the Dharma "Slice" have in common is their association with diabase dykes. The dykes are of different ages but the fractures they occupy are related to a common event. Major east-west shear zones separate the three segments (figure 2). The "Corridor of Hope" and "Diamond Corridor" are generally zones of low gravity but the zones are poorly defined. The Lac de Gras kimberlite field coincides with a large negative Bouguer anomaly indicating less dense lithosphere (O'Reilly et al. 2001) as do other important kimberlite occurrences within the "Corridor of Hope".

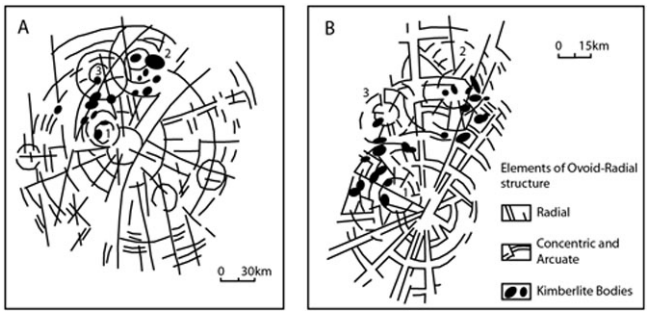

Figure 5: Circular structures of Vilyui subprovince of the Siberian Platform determining distribution of different-rank diamond bearing areas (taxons) as adapted from Gavrilov 1999. Circular structures and related diamond bearing fields: (1) Daldin-Markha, (2) Daldin and (3) Sytykan.

There is reason to believe that the Buffalo Hills and Birch Mountain kimberlite fields in Alberta are the southern extension of the Slave "Corridor of Hope" displaced 500 km west on the Great Slave shear zone. The Fort a la Corne kimberlite field may be on a further southern extension displaced back to the east. Figure 6 is the digital first vertical derivative magnetics (GSC 2011) that shows the major Western Canadian diamond fields from Darnley Bay to Fort a la Corne reassembled into a single corridor.

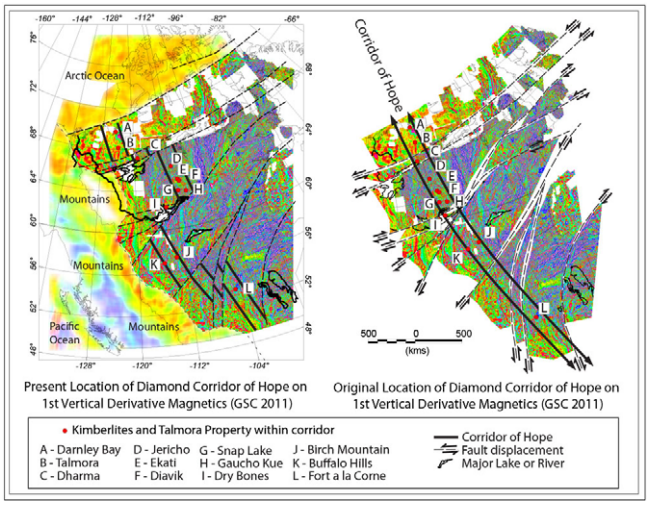

Figure 6: Restoration of "Corridor of Hope" (right) extending from Darnley Bay to Fort a la Corne based on digital first vertical derivative of the total field magnetics (G.S.C. 2011).

Drybones is in a wedge shaped slice south of the Slave Province. The "Corridor of Hope" shows a rough relation to the edge of the Cordilleran fold belt which on average is 490 km to the west. The blocks displaced to the west are a little

closer (420 km) to the fold belt and those displaced to the east are a little further (565 km) from the fold belt.

The NNE trending Western Corridor of the Slave Province north of Drybones may reflect a reactivation of the process that formed the "Corridor of Hope" after the latter's southern extension was displaced to the west and the geometry of the process changed.

Morphostructures have not been a factor in the search for kimberlites in Canada. The Darnley Bay kimberlite field on the Parry Peninsula lies within a circular feature, thought by some to be caused by a meteorite impact, but is very likely a circular morphostructure as smaller circular structures can be seen within it (figure 7). Dharma lies within a large circular morphostructure as well but smaller circular structures within it are not evident. The numerous magnetic targets on the Talmora property lie within a very well defined circular mesostructure (40 km diameter) containing many smaller circular mesostructures. The Talmora mesostructures lie within a well defined megastructure (200 km diameter).

Formation of the Corridors or Zones of Anomalous Mantle

Lena West and Lena East are platform areas where the Archean is covered by Proterozoic &/or Paleozoic and younger rocks. The Lena West ZAM and its southern extension into the Slave province is approximately the same length as the Lena East ZAM. Each ZAM runs roughly parallel to a major fold belt.

The distance of the Cordilleran fold belt from the Lena West "Diamond Corridor" is 450-500 km and from the Slave "Corridor of Hope" is 550-575 km. South of the Slave Province it is 530 km from Drybones, 300-430 km from Buffalo Hills/ Birch Mountain and 550 km from Fort a la Corne.

The Lena East linear corridor lies 250-600 kilometers west of the oblique trending Verkhoyansk folded system that then bends and cuts the Linear at right angles. It is more nearly parallel to the Akitkan Proterozoic fold belt. Mirny is 250 km NW of the exposed part of the Akitkan fold belt which is projected to the NE beneath the Siberian Platform cover as an aulacogene byKaminsky et al (1995) or by Rosen et al (1994) as the Akitkan fold belt with a rift to the NW as in figure 4. Poudjom Djomani et al (2003) found unusually high values of elastic thickness Te (typical of stabilized Proterozoic lithosphere) over both fold belt and rift and suggest that the strong lithosphere beneath the rift may reflect the development of the fold belt. This would put the Proterozoic fold belt 250 km from the Alakit/Daldyn/Muna diamond fields.

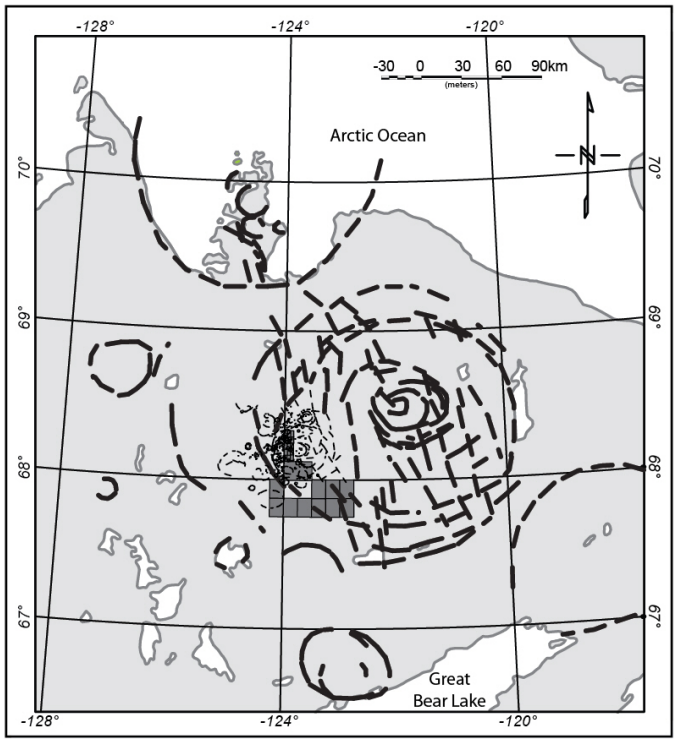

Figure 7: Regional morphostructures from topographic map (thick black) and detail morphostructures around Talmora property from landsat and topographic maps (thin black).

Helmstaedt (2009) has put forward a model (figure 8) for the Slave craton in which Paleoproterozoic lithosphere has underplated Mesoarchean lithosphere beneath the "Corridor of Hope". The geometry of the corridor is related to the subducting plate. It is significant that the western edge of the underplating Proterozoic is 270km west of the Lac de Gras "Corridor of Hope". The model is based on the Northern Cordillera Snorcle seismic transect.

Presumably Proterozoic rocks underplated the Archean the full length of the Cordilleran fold belt. Where the edge of the Proterozoic is covered by younger rocks the edge of the Cordilleran fold belt may be considered a rough proxy for the edge of the western Proterozoic of North America.

Conclusions

Helmstaedt's model for the Slave "Corridor of Hope" may apply to the Siberian linear. There is evidence that the geometry of the Siberian linear is related to the Akitkan Proterozoic fold belt. Both zones of anomalous mantle could be associated with subduction during folding along the margin of an Archean craton and the accretion of Proterozoic material to the craton.

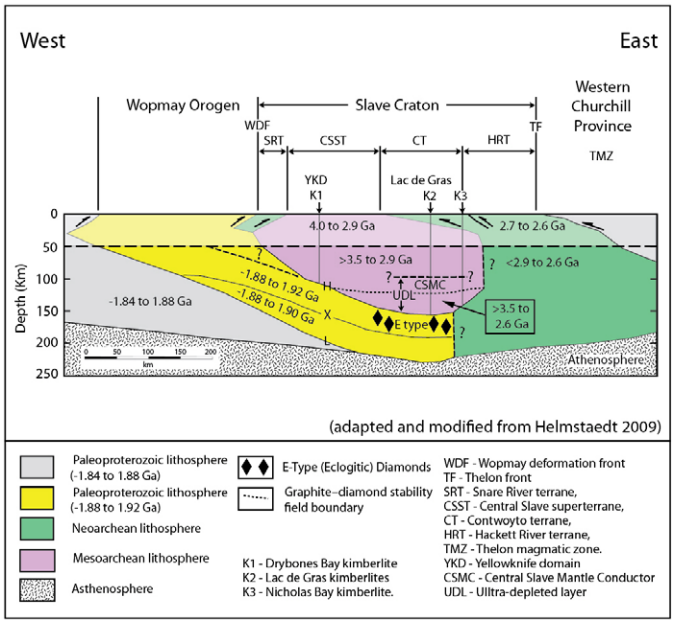

Figure 8: Cross-section through lithosphere of Slave Province between Wopmay deformation front and Thelon front. E-type diamonds (open diamond symbols) in eclogite lenses within underplated Paleoproterozoic lithosphere.

It is concluded that a single Archean craton was underplated during Proterozoic time and resulted in a single zone of anomalous mantle that was subsequently cut in two by the Aekit orogenic belt. The Aekit orogeny thinned and destroyed the base of the Siberian half of the craton and presumably would have done the same to the North American half.

Thinning is not evident from the mineralogy of the Darnley Bay kimberlites although very little work has been done on them. However, thinning may be expected in basement rocks that originally lay between Darnley Bay and Siberia. These rocks were rotated out of the way and now lie beneath the north slope of Alaska.

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