GENESIS OF DIAMOND PLACERS ON THE GUIANA SHIELD, SOUTH AMERICA.

Grubb, [(1), (2)]Mark D. and McCallum, [(2)]M.E.

(1) P.O. Box 725, Tehachapi, CA 93581; (2) Dept. Earth Resources, Colorado State Univ., Fort Collins, CO 80523.

Detailed geological and geomorphological field investigations in the Issineru-Enachu mining district of Guyana were combined with analyses of the sedimentary sequence in the Guiana Basin and regional scale geomorphic analyses of the Guiana Shield to form a coherent placer genesis model for the region. Placer deposits are the result of interactions between three parameters: 1) source rock, 2) regional geologic setting, and 3) regional and local geomorphic evolution.

The principal source for diamond on the Guiana Shield is inferred to be fluvial deposits of the Proterozoic Roraima Group (Fig. 1). Although no diamonds have been found in these rocks, the spatial coincidence of diamonds and the Roraima Group offers strong evidence that this is their major source on the Shield. The Roraima Group is composed dominantly of orthoquartzite, quartz arenite, quartzose and polymictic conglomerate, and arkosic arenite. The depositional environment of these sediments is interpreted to be a series of coalescing wet-type alluvial fans that accumulated to more than 3000 m thick. Structural, sedimentological, and paleocurrent data suggest that the present northeastern escarpment of the Roraima Group closely approximates the Roraima sedimentary basin margin. Fan-head depositional sites of this type are well documented as sites of placer enrichment (Schumm, 1977; Minter, 1978).

The geomorphic mechanisms responsible for placer formation of diamonds on the Guiana Shield are eluvial concentration due to humid tropical climate weathering and fluvial transportation coupled with sorting and concentration in a semiarid climate. The latter mechanism is enhanced by two factors: 1) multiple rapid shifts between humid tropical rain-forest conditions and semiarid savannah type conditions that have been documented for at least the Pliocene to the Holocene and 2) low amplitude episodic epeirogenic uplift of the Guiana Shield (Table 1). Extensive sedimentological, palynological, geochronologic, and geomorphological evidence support the model (Pflug, 1969; Damuth and Fairbridge, 1970; Van der Hammen, 1972).

Fluvial system instability resulting from either climate change or uplift typically leads to a complex response, and, in the Guiana Shield region, this is reflected by evidence of repeated aggradation and incision of alluvial valleys as the system continually readjusted toward equilibrium. Such oscillations result in the repeated reworking of alluvium that is a requisite to placer formation (Schumm, 1977; Lampietti and Sutherland, 1978). The modern fluvial system on the Guiana Shield is entrenched into a stripped etchplain that is thinly veneered by regolith and alluvial sediments (Fig. 2). Consequently, location and grade of placer deposits are controlled mainly by bedrock structural fabric, a situation that is highly conducive to placer concentration.

Phanerozoic age low amplitude episodic uplift is evidenced by six major regional planation surfaces cut into the Shield. Crustal flexure of the trailing edge continental margin created profound bedrock nickpoints in trunk streams draining into the Atlantic Ocean and has isolated the

upland fluvial systems from sea level fluctuations associated with glacial-interglacial cycles (Fig. 2). This isolation prevented wholesale stripping and transportation of alluvium from the uplands and allowed repeated reworking of pre-existing and newly created sediments into high grade placers. The 1:1 ratio of gem to industrial diamonds recovered in much of Guyana reflects extensive reworking of the placer diamonds and contrasts strongly with the lower ratios associated with primary diamond sources such as kimberlite pipes.

Uplift of the Guiana Shield combined with episodic climatic shifts has resulted in the development of two widespread Pleistocene age terraces underlain by braided river alluvial deposits and a deep, Holocene age, gravel-rich valley fill in the Issineru-Enachu mining district. Placer grade and diamond quality increase in progressively younger terraces and ultimately in the valley fill. The valley fill underlying the modern fluvial system has undergone a minimum of four dramatic erosion-sedimentation cycles, resulting in a gem to industrial diamond ratio of greater than 2:1.

Reconnaissance sampling indicates that more than 100 million cubic yards of ore gravel occurs in the valley fill within the mining district, assuming an ore horizon of 1 m. This estimate includes well developed point bars associated with the trunk stream in the district, the Mazaruni river. Overburden beneath the floodplain of the Mazaruni River is inferred from seismic refraction measurements to be from 7 m to more than 18 m thick.

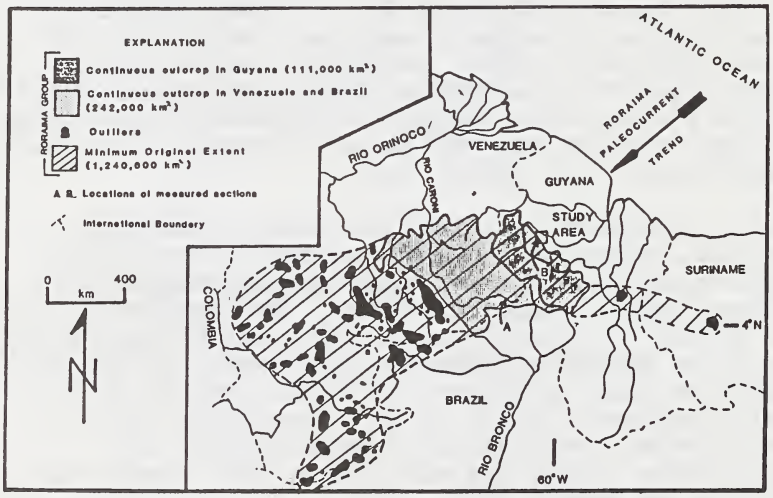

Figure 1. Map depicting the extent of Roraima Group rocks and their general paleo-current trend. Modified from Keats (1974).

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Table 1. Pliocene to Holocene geologic and geomorphic history of northern Guyana proposed as a model for the Guiana Shield.

AGE	SEDIMENTARY DEPOSITS		GEOMORPHIC SURFACE ON THE GUIANA SHIELD (elevation, m above mean sea level)	INFERRED PALEOCLIMATE
	GUIANA BASIN	GUIANA SHIELD		
HOLOCENE	(D)	(D)	Mazaruni (70 - 90)	HUMID TROPICAL
PLEISTOCENE	(B)	(B)		SEMIARID
	(C)	(C)		HUMID TROPICAL
PLIOCENE	(M)	(M)	Llanos (100 - 170)	SEMIARID

(D) DEMERARA ALLOFORMATION. Well sorted coarse to fine sand and clay.

(B) BERBICE ALLOFORMATION. Coarse to fine, angular, poorly sorted sand that locally contains gravel and is locally arkosic. Includes a carbonate reef allomember.

(C) COROPINA ALLOFORMATION. Silty loam, clay and pyrite bearing peat.

(M) MACKENZIE ALLOFORMATION. Coarse to fine angular, poorly sorted, sand that locally coantians gravel and is locally arkosic.

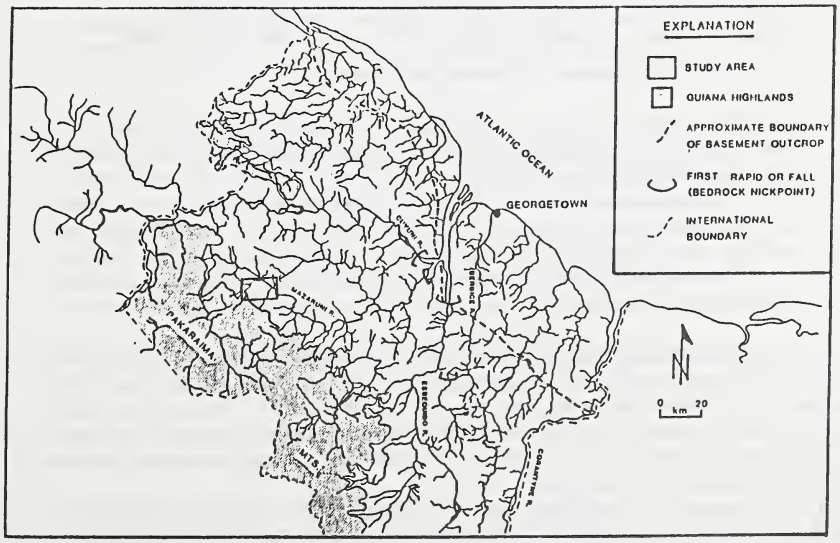

Figure 2. Map of Northern Guyana illustrating the bedrock nick-points and the approximate hingeline of crustal flexure as indicated by the trace of basement outcrop.