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PRELIMINARY NOTES AND OBSERVATIONS ON ACTIVITIES IN THE FIELD DURING THE PERIOD OF JUNE 23 TO JULY 3: INVESTIGATIONS OF THE OCCURRENCE OF DIAMONDS IN PLACER GRAVELS ON CROOKED CREEK NEAR CENTRAL, ALASKA

By

J.T. Kline

Alaska Division of
Geological and Geophysical Surveys

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794 University Avenue, Basement
Fairbanks, Alaska 99701

PRELIMINARY NOTES AND OBSERVATIONS ON ACTIVITIES IN THE FIELD DURING THE PERIOD OF JUNE 23 TO JULY 3 AND SEPTEMBER 10 TO SEPTEMBER 16: INVESTIGATION OF THE OCCURRENCE OF DIAMONDS IN PLACER GRAVELS ON CROOKED CREEK NEAR CENTRAL, ALASKA.

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INTRODUCTION

A field party including Robert B. Forbes, affiliated with DGGS, Al Clough of U.S Bureau of Mines and J.T. Kline of DGGS in Fairbanks, began field investigations into the occurrence of diamonds on Crooked Creek in the Circle Mining District, the first documented diamond occurrences in the State.

Three diamonds found in the summers of 1982, 1984 and 1986 on Crooked Creek claims within approximately one to two miles of each other have spurred interest about the geologic circumstances and history of their occurrence. The diamonds were recovered during normal cleanups in concentrates derived from Ross type sluice boxes on separately held claims. The conditions under which the diamonds were discovered , and their character makes it highly likely that more are present, and that their existence is not merely a fluke.

The first diamond to be discovered on Crooked Creek was found in 1982 by Don Lasley during a cleanup of Ross Box concentrates on Claims held by James Reagan of Fairbanks. It is a white octahedron which weighs approximately 0.3 carats. The second diamond was found about 1.5 miles down stream during a cleanup of Ross box concentrates by Mary Warren on Claims held by Frank and Mary Warren. Their diamond is a pale yellow irregular dodecahedron which weighs 1.4 carats. a third diamond weighing 0.83 carats was found during 1986 mining operations by Paul Manuel on claims leased from Frank Warren about 1/4 mile downstream from the location of the 1.4 carat diamond find. The third find appears to be a pale yellow, twinned dodecahedron with conspicuous seams on its rhombic crystal faces. All of the stones show some evidence of abrasion and percussion however all have recognizable crystal habits. All three stones fluoresce under long wave ultraviolet radiation.

In all of the above cases large volumes of material were being sluiced in boxes set at steep angles with water flow being around 4,000 gal/min. This situation alone makes the retention of a diamond with its specific gravity being close to 3.5 unlikely, because even though a diamond is denser than a majority of material moving through the sluice, it is much lighter than the material which the sluice was set up to retain (i.e. gold with a specific gravity between 15 and 19). The likelihood of capturing a diamond in a sluice under these circumstances is small.

Another factor which makes the early discoveries even less probable is that to the untrained eye a rough diamond may not appear particularly remarkable and is likely to be ignored by a miner who is looking for heavy metallic minerals, especially gold. Many rough diamonds are irregular and have developed coatings or pitting due to concussion and abrasion during transport. The two diamonds which were found on Crooked Creek retained their characteristic crystal forms and were distinctive enough relative to other minerals in the concentrates such as quartz, to attract attention.

With the above factors operating, making diamond recovery and recognition unlikely, even in proven diamond bearing gravels, it seems intuitively likely that more diamonds exist in the gravels of Crooked Creek, and that if properly handled and concentrated additional diamonds will be found.

PURPOSE OF THIS STUDY

Our objectives in this investigation were to:

1) DETERMINE THE NATURE AND POSSIBLE SOURCES OF THE GRAVELS BEING MINED.

2) TO LOOK IN CONCENTRATES FOR KEY INDICATOR MINERALS COMMONLY ASSOCIATED WITH THE OCCURRENCE OF DIAMONDS AND THEIR HOST ROCKS.

3)USE A GREASE TABLE TO ATTEMPT TO RECOVER MORE DIAMONDS FROM CONCENTRATES AT THE TWO MINES WHERE THE KNOWN DIAMONDS WERE FOUND.

4) INVESTIGATE THE OVERALL GEOMORPHIC HISTORY OF THE AREA AND ATTEMPT TO DETERMINE WHETHER THE DIAMONDS FOUND TO DATE HAVE UNDERGONE A SIMPLE OR COMPLEX HISTORY OF TRANSPORT AND REDEPOSITION FROM THEIR ORIGINAL PARENT SOURCE.

5) EXAMINE THE CHARACTER AND DISTRIBUTION OF GOLD AND GOLD PLACERS TO ATTEMPT TO IDENTIFY CONCENTRATING MECHANISMS AND CONDITIONS WHICH MIGHT HAVE LEAD TO THE CONCENTRATION OF MINERALS SUCH AS DIAMOND WHICH ARE LESS DENSE THAN GOLD.

6) CHARACTERIZE THE SO CALLED "FALSE BEDROCK" UPON WHICH PAY GRAVELS ARE DEPOSITED, AND DETERMINE IF IT HAS SUPPLIED EITHER THE GOLD BY RECONCENTRATION OF ANCESTRAL GRAVELS, OR HAVE POSSIBLY BEEN A SOURCE OF DIAMONDS.

GEOLOGIC SETTING

Alluvial gravels containing placer gold and which produced the Crooked Creek diamonds lie within the Tintina fault zone. This zone is bounded on the northeast by the Preacher strand and the southwest by the Hot Springs strand [1] (Foster and others, 1980), and in this area consists of a Tertiary basin filled with an unknown thickness of continental clastic rocks ranging in age from at least as old as Miocene (Weber and Foster 1981) possibly through Pliocene(?), which are in turn overlain by from five to 100 ft. of Quaternary flood plain,terrace and fan gravels. Potential source areas for the Tertiary basin fill are the Crazy Mountains on the north and the Yukon-Tanana Upland to the south. Lithologies in the Crazy Mountains consist of late Proterozoic(?) through late Paleozoic sediments, metasediments, and volcanics.Predominant lithologies of the Yukon-Tanana Upland to the south include greenschist and amphibolite facies metamorphic rocks, intruded in places by granitic plutons of late Cretaceous age. A few mafic and ultramafic bodies occur in apparent association with the Hot Springs fault within Yukon crystalline rocks of the Y-T Uplands.

Crooked Creek itself heads in the Yukon-Tanana Upland and drains northward across a graben defined by the two major strands of the Tintina fault, and is a tributary of Birch Creek. Its drainage basin morphology is indicative of a complex history of changes in regional and local base level as well as course.

Significant changes in stream regimen have resulted in multiple cycles of aggradation, rejuvenation and down cutting. The present stream is incised approximately 100 ft. into its own fan gravels within the formerly mentioned graben section. The width of the incision is between 1,000 and 3,000 ft.

STRATIGRAPHIC CONTEXT

The general stratigraphy seen in placer mining cuts in the graben section of Crooked Creek consists of three to five feet of dark grey laminated organic fluvial overbank silt and minor sand overlying five to fifteen feet of Holocene(?) or late Pleistocene grey to brown cobble,small boulder gravel with some sand, overlying an unknown thickness of highly weathered yellow-orange to red cobble-boulder gravel with a sandy clay matrix (herein informally referred to as 'Crooked gravel'). In places it appears that another intermediate unit, somewhat older than the majority of the upper gravel being mined forms the fillings of ice wedge casts into the yellow-orange 'Crooked gravel'. This intermediate unit could in some cases represent remnants of the fan into which modern Crooked Creek has incised.

The upper gravel consists of clasts predominantly derived from schists, quartzites and granitic rocks of the Yukon crystalline terrane to the south. It carries a majority of the gold being mined in the area according to local miners. The highly weathered 'Crooked

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[1] A MYLONITIC FAULT CONTACT JUXTAPOSING AN UNKNOWN THICKNESS OF CLAY RICH, ORANGE GRAVEL ON THE NORTHEAST WITH BLUE GREY GRAPHITIC SCHIST AND PHYLLITE ON THE SOUTHWEST WAS EXPOSED BY MINING OPERATIONS ON CROOKED CREEK .3 MI. UPSTREAM FROM THE CONFLUENCE OF SAW PIT CREEK. THE OBSERVED FAULT IS LOCATED WHERE AN INFERRED FAULT NAMED THE HOT SPRINGS FAULT BY WEBER AND FOSTER, 1982, WAS BELIEVED TO CROSS CROOKED CREEK.

gravel' has a less clear cut source, though after examination of many mine cuts it is inferred that the dominant source is from within the Yukon-Tanana Upland. Due to its advanced degree of weathering most non quartz components have been altered to clay. Iron oxides from weathered schist clasts impart an intense yellow to orange and red color to the 'Crooked gravel'. The intensity of weathering or alteration decreases in a downstream direction from the Hot-springs strand of the Tintina fault where it crosses Crooked Creek. Most of the igneous clasts have weathered to gruss or clay. X-ray and other petrographic work is pending on samples of the 'Crooked gravel' to determine clay minerology of weathered matrix material to attempt to get a better handle on its age and possible origin, and the mechanism responsible for the intense weathering or alteration noted. In some places the upper portion of the yellow-orange 'Crooked gravel' exhibits till-like characteristics. In these places it appears as a bouldery diamictite with a sandy clay matrix, with boulder and cobble clasts showing no fabric of preferred fluvial orientation. These characteristics are hard to evaluate with the limited exposures available in mining cuts and may be due to the high degree of weathering and possible past exposure to periglacial processes. It is believed that volume changes due to hydration and alteration along with cryoturbation (frost churning) and the original poor degree of fluvial sorting of the original deposit are responsible for the diamictic appearance .

It is difficult to evaluate the depth and uniformity of weathering in the 'Crooked gravel' since we were not able to observe exposures of the material to a depth of more than a few feet. Miners in the area who have used churn drills to test the 'Crooked gravel' report that it exceeds a thickness of 90 ft. immediately adjacent to its contact with Yukon crystalline rocks at the Hot Springs fault implying at least 90 ft. of vertical throw on the fault since its deposition.(Fig) (to our knowledge the bottom has not been reached in any drill tests on Crooked Creek). The 'Crooked gravel' has not been reported from localities south of the fault implying that any portion of it which did extend south of the fault has been stripped by erosion accompanying uplift on the southern side. Throughout its drilled thickness the 'Crooked gravel' is reportedly uniformly clay rich and weathered (Stanley Gelvin, verbal communication 1985). Since churn drilling was employed to test the gravels some of the apparent clay content in the bailer samples could have resulted from slaking of upper portions in the hole.

Shallow fresh cuts made into the 'Crooked gravel' made by Frank Warren for the purpose of our examination, showed wedge-like fillings in the upper few feet which may be ice wedge casts in some cases and cut and fill channel structures in others. Mine operators generally remove and process the upper auriferous gravel down to the contact with the 'Crooked gravel' , which the miners commonly refer to as false bedrock or 'the Tertiary'. Once the upper gravel is removed the surface of the 'Crooked gravel' exhibits an anastomosing polygonal or sinuous pattern of what appears to be former ice wedge polygons as well as stream channels which have been subsequently filled by gravels of the upper unit. Where these apparent ice wedges casts intersect, larger pockets of the upper gravel occur as fillings. These pockets are usually 5-20 ft. across and three to eight feet deep. Such pockets of upper gravel are commonly selectively scooped out by miners as they often contain relatively good gold values.

Approximately 2,000 ft. upstream from the Warren mine a fairly abrupt color change occurs in the 'Crooked gravel'. The change is characterized by an increase in chroma and overall uniformity of iron staining, as well as an increase in the apparent degree of weathering. Remnants of highly weathered schistose pebbles,cobbles and boulders are more apparent. A possible explanation may be that the 'Crooked gravel' is deformed and is dipping to the north . This would cause gravels up stream from the Warren mine to be deeper in the section and thus older. Alternatively their could be another fault north

of the hot springs fault which is down on the north resulting in a higher portion of the section being exposed at the Warren mine than is seen on its upstream side to the south. A third possible explanation may relate to the Hot springs fault as a possible past source of low temperature epithermal fluids which have influenced the degree of alteration of the lower unit.

Other mining cuts along Deadwood and Portage Creek , north of the Hot springs fault expose similar highly weathered and oxidized gravel units 5-20 ft. below younger Quaternary gravels.

NATURE OF PLACER DEPOSITS

The general tenor of gold bearing gravels being mined in Crooked Creek down stream from the confluence of Bedrock Creek to the town of Central is low. Miners in this stream segment report values ranging from $2.50 to $5.00 per yard (with gold prices at approximately $320/oz.) . While pay may occur in any part of the upper gravel and richer pockets do occur, well defined pay streaks seem to be the exception. The richest gravels seem to be within the Crooked two or three feet of the upper gravel. It appears likely that gold being mined on Crooked Creek, downstream from the Hot Springs fault has been reconcentrated from its own former fan, which has been incised to a depth of 100-120 ft. by the modern stream. Prospect cuts made in the fan-terraces flanking the modern stream have confirmed the presence of gold in the fan but at subeconomic concentrations.

Panning tests performed by our group from locations in the walls of mine cuts showed that the vertices of ice wedge casts penetrating into the Crooked, highly weathered older gravel, and filled by younger grey to brown gravel produced the most colors per pan. Despite this it is only feasible for operators to mine the intersections of wedges where there is enough room to scoop out the relatively rich pockets with out getting an undesirable admixture of the 'Crooked gravel', which due to its clay rich character tends to clog sluice riffles and actually carry away gold which has already been entrapped. The base of channel fills at the disconformity between the older and younger gravels also seemed to carry somewhat higher values.

NOTES ON THE CHARACTER AND FORM OF CROOKED CREEK GOLD

The majority of gold recovered from sluicing operations on Crooked Creek down stream from the Hot Springs Fault is fine grained, flattened, and highly abraded. Flattened grains commonly are curved or hooked, probably from being molded between gravel clasts. Fineness averages around 870 and tends to increase gradually downstream from the Hot Springs fault, while at the same time the mode of gold grain size gradually decreases in a downstream direction.

Discussion with several miners in the area disclosed that gold fineness and particle size distribution changes abruptly upstream from the Hot Springs fault, whose position is also roughly coincident with the head of the abandoned and incised alluvial fan.

Upstream from the fault gold fineness drops below 840 and its coarseness increases. The tenor of the gravels is also apparently much Crooked above the fault and upstream until just below the confluence of Porcupine and Mammoth Creeks.

Still needed for this study:

TRACE ELEMENT AND ALLOY COMPOSITION OF IMPURITIES IN GOLD, BOTH UPSTREAM AND DOWNSTREAM FROM FAULT.

PHOTOMICROGRAPHS FOR TKB COLLECTION AND FOR THE FINAL CROOKED CREEK REPORT

SEMI-QUANTITATIVE SIZE RANGE NUMBERS FOR DETRITAL GOLD AT VARIOUS STATIONS ALONG CROOKED CREEK.

SIEVE ANALYSIS NUMBERS AND PLOTS FOR BULK STRATIGRAPHIC SAMPLES COLLECTED FROM VARIOUS HORIZONS IN MINE CUTS.

DIAGRAMS SHOWING CROSS AND LONGITUDINAL PROFILES THROUGH SURFICIAL DEPOSITS ,AND A SEQUENCE ILLUSTRATING THE HYPOTHESIZED HISTORY OF THE FLUVIAL SYSTEM .

DISCUSSION OF DISCREPANCIES BETWEEN OUR DATA AND OBSERVATIONS AND THOSE OF YEEND, 1982.

PEBBLE COUNT DATA FOR UPPER AND 'CROOKED GRAVEL'S AND FAN GRAVELS.

DISCUSSION OF LITHOLOGIES SEEN IN ALLUVIUM ALONG ALBERT CREEK.

DISCUSSION OF THE HYPOTHESIS THAT THE YUKON RIVER ONCE FLOWED BETWEEN THE Y-T UPLANDS AND THE CRAZY MOUNTAINS, CLOSE TO CENTRAL AND THE AREA IN QUESTION ON CROOKED CREEK.

RETURN TO THE HIGH TERRACE BETWEEN BIRCH CREEK AND THE YUKON RIVER TO MEASURE THE GRAVEL PIT SECTIONS AND COLLECT MORE PLANT MATERIAL--TRY TO DETERMINE IF THE WEAKLY CEMENTED TERRACE GRAVELS THERE ARE PLEISTOCENE OR LATE TERTIARY AS THERE MAY BE A CONNECTION BETWEEN THESE AND THE CROOKED WEATHERED GRAVEL EXPOSED BY MINING IN THE TINTINA FAULT ZONE.

References still incomplete

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