Revisiting a resource: Yukon's "technogenic" placer deposits

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While mining in non-traditional areas of Yukon is increasing, exploration and mining of placer gold in historic placer regions continues. In order to facilitate this, increasingly innovative mining and exploration methods must be employed.

Using a combination of historic and modern exploration tools, it is possible to delineate placer gold deposits in areas which were previously thought to be exhausted of reserves. These placer settings are sometimes referred to as 'technogenic', a term used to describe original gravel remnants and gold-bearing tailings which formed as a consequence of inefficient technology or poor mining techniques. These deposits may now be exploited using modern exploration and mining methods.

Most workers involved in the study and mining of placer deposits know that characterizing the grade and overall value of placer deposits is a difficult and sometimes impossible task. With this in mind, the figures used in the following text are best estimates based on a combination of documented records (i.e., from Yukon Consolidated Gold Company records), Yukon Geological Survey sampling, and anecdotal reports from miners and other workers in the goldfields (Yukon Placer Database, LeBarge [comp.], 2007). The author welcomes any and all information on the grade and value of Yukon placer deposits to improve these figures.

Types of technogenic placer deposits

Although they do not comprise a large component of the existing placer reserves in the Yukon, there are several examples of technogenic placer deposits, mainly situated in the historic Klondike and Sixtymile placer mining areas (Fig. 1). There are five main types of resources which can be classified according to their previous mining activity: 1) hand-mined creeks and gulches, 2) hydraulically mined areas, 3) dredged alluvial plains, 4) mechanically mined areas, and 5) combinations of one or more of the above types.

Hand-mined placer deposits

In creeks and gulches which were once hand-mined (mostly by Klondike gold rush miners), the gravels have variable sedimentological characteristics, but are commonly pebble-cobble gravels with little clay. Previous miners may have had problems recovering gold because of permafrost, the presence of large boulders, or undulating bedrock conditions. In addition, parts of the original stream channel may have been obscured by bedrock reefs and colluvium. Original grades were usually high (consistent grades of more than an ounce per cubic yard [>30 g/m^3] and sometimes much higher; see "Richness of Yukon Gold," Olynyk, this volume), and the volume was characteristically low. Grades in tailings are variable but can range form 0.010 to 0.125 oz/yd^3 (0.35 to 4 g/m^3). Modern access is characteristically good, and today's miners can use hydraulic mining or mechanized mining methods to recover much of the remaining placer gold (Fig. 2).

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Hydraulically mined areas

Hydraulically mined areas are those where human-made alluvial fans were created as a result of hydraulic monitoring (washing) of terrace gravels, such as the historic White Channel gravels (Fig. 3). These deposits are typically cobble-boulder gravel with the clay matrix mainly removed through the previous washing process. Originally the gold grades were variable, from low to high (0.010 to 0.30 oz/yd^3; 0.35 to 10 g/m^3) and locally very high, with large volumes. There remains in some areas low to moderate

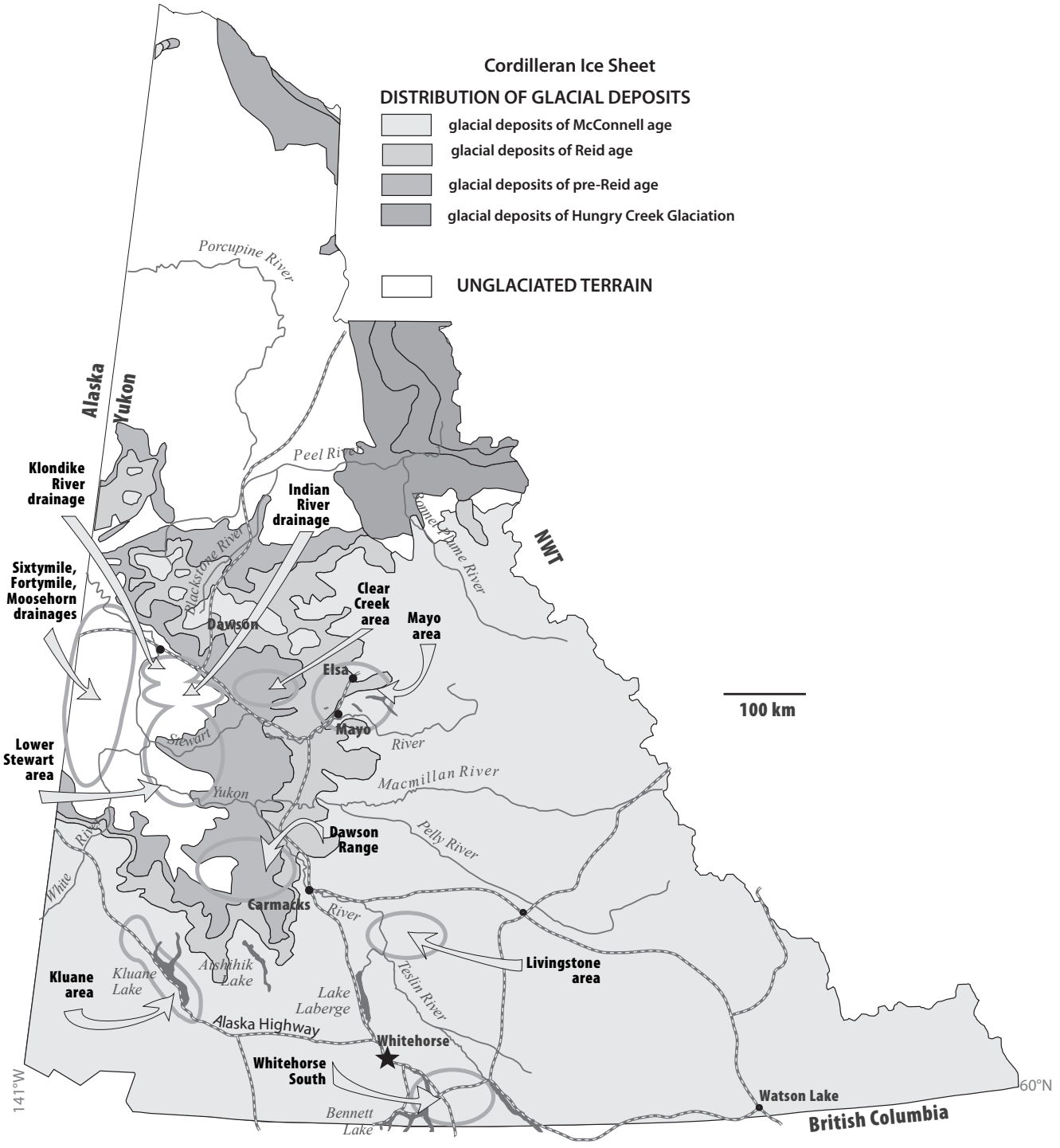

***Figure 1**. Technogenic placer deposits occur in each of the ten major placer mining areas in the Yukon. Technogenic placers which were hand-mined, hydraulically mined and dredged tend to occur in the unglaciated, traditionally mined areas, while mechanically mined technogenic placers are more common in glaciated, non-traditional mining areas. Glacial limits are modified after Duk-Rodkin (1999).*

***Figure 2**. Buried channels of virgin gravel are occasionally discovered, having been initially obscured by bedrock reefs such as here on Bonanza Creek. Old timers often mined such high-grade material that even their tailings contain economic gold at today's prices.*

***Figure 3**. In the Klondike, human-made alluvial fans were often created during hydraulic mining of the high-level White Channel Gravel terraces, such as here on Last Chance Creek. In addition to containing sporadic, locally economic, concentrations of gold, these hydraulic fans locally buried virgin alluvial gravels and old timers' workings containing economic gold values.*

***Figure 4**. Dredge tailings are easily recognized by the inverted stratigraphy and unusually well-developed planar tabular cross-stratification. Gold values in these tailings are rarely economic, however, combined with pockets of virgin gravel in undulating bedrock, there may be a mineable technogenic placer deposit.*

grades in tailings (0.005 to 0.015 oz/yd^3; 0.15 to 0.5 g/m^3). Advantages to this deposit for modern miners include the absence of permafrost and the lack of overburden, as well as excellent road access.

Dredged alluvial plains

Dredged alluvial plains are areas that have had historic large-scale dredging, mainly in the Klondike, but also in other parts of the Yukon such as Mayo and Clear Creek. Sandy cobble-pebble gravels are typical and the original stratigraphy is inverted – bedrock is overlain by silt and then gravel (Figs. 4 and 5). The original grades were variable but generally moderate (0.01 oz/yd^3; 0.35 g/m^3) and the volume was high, however, in the tailings the gold grades are typically low to very low. Advantages for modern mining are the fact that previously frozen ground is now thawed and there is little to no overburden. Modern miners can take advantage of the good road access and can use large-scale mechanized stripping and mining methods.

Mechanically mined placer deposits

With the advent of modern mechanized mining in the mid 20th century, several new placer mining areas began to be exploited in the Yukon. Several of these areas were mined with equipment that was too small to deal with the size of the boulders or the presence of hard permafrost. Mechanically mined areas with remnant reserves are commonly boulder-cobble gravels, which were clay-rich originally, and may still be to some extent. The grades were originally moderate to high (0.01 to 0.20 oz/yd^3; 0.35 to 7 g/m^3), with a moderate to high gravel volume. Tailings contain generally low to moderate grades that are somewhat unpredictable. Deposits are discontinuously thawed and, in places, overburden complicates mining; in addition, access may be limited. Modern miners use larger equipment and more efficient processing plants to overcome the problems that were faced by previous miners (Fig. 6).

***Figure 5**. On Sixtymile River, dredges were unable to completely clean the undulating bedrock surface. Pockets of economic virgin gravel were left behind and buried under dredge tailings, waiting to be re-exposed by today's placer miners.*

***Figure 6**. On Fourth of July Creek, economic placer gravels have been found beneath previously mined gravel layers. Newer mining technologies such as floating trommel wash plants have helped to overcome past difficulties such as mine pit drainage problems.*

Combination technogenic placer deposits

Several technogenic placer deposits in the Yukon can be characterized as combination areas. These are deposits where one or more of the other types of technogenic placer deposits are found, along with pockets, pillars and channels of original gold-bearing gravels (Figs. 7, 8 and 9). These include 1) previously undiscovered channels obscured by bedrock remnants; 2) original gold-bearing gravels buried in hydraulic tailings; 3) pillars of original gravel covered by dredge tailings; 4) pockets of original gravel in undulating bedrock; 5) remnants of original gravels on valley sides; 6) unmined gold-bearing gravels beneath previously mined pay layers, and 7) gold-bearing gravels which lie beneath the water table (Fig. 7).

Conclusions

In many areas of Yukon, previous mining in traditional areas has not recovered all of the placer gold which originally lay within the gravels and bedrock. Using a combination of research, modern exploration techniques and modern mining methods, it is possible to revisit many of these deposits and economically recover placer gold. Due to several factors which include good road access, thawed ground and little or no overburden, these technogenic deposits in the short term may be more profitable than developing new placer deposits in new, non-traditional areas.

References

Dul-Rodkin, A., 1999. Glacial limits map of Yukon (1:1 000 000 scale). GSC Open File 3694; also known as EGSD Open File 1999-2.

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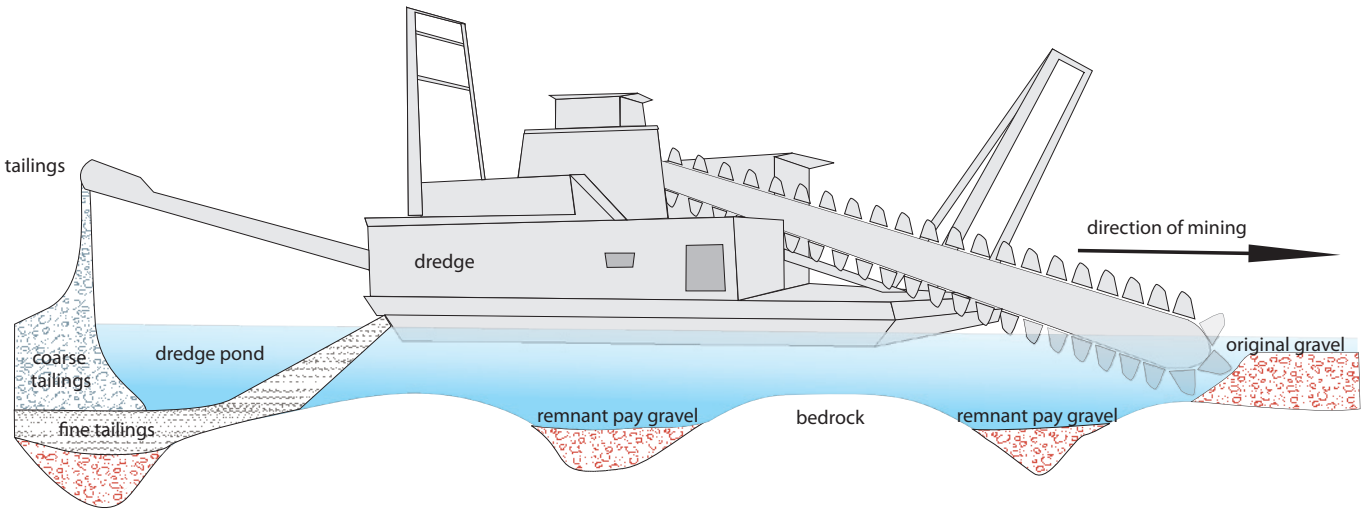

Figure 7*. The making of a "technogenic" placer deposit. Dredges sometimes lacked the capability to scour all of the gravel from a bedrock surface that was undulating, frozen, unusually hard or fractured. Pockets of virgin gravel would be left and subsequently buried by fine and coarse dredge tailings. If these pockets are sufficiently rich, it may be economic to re-excavate and mine these deposits with modern mechanized equipment.*

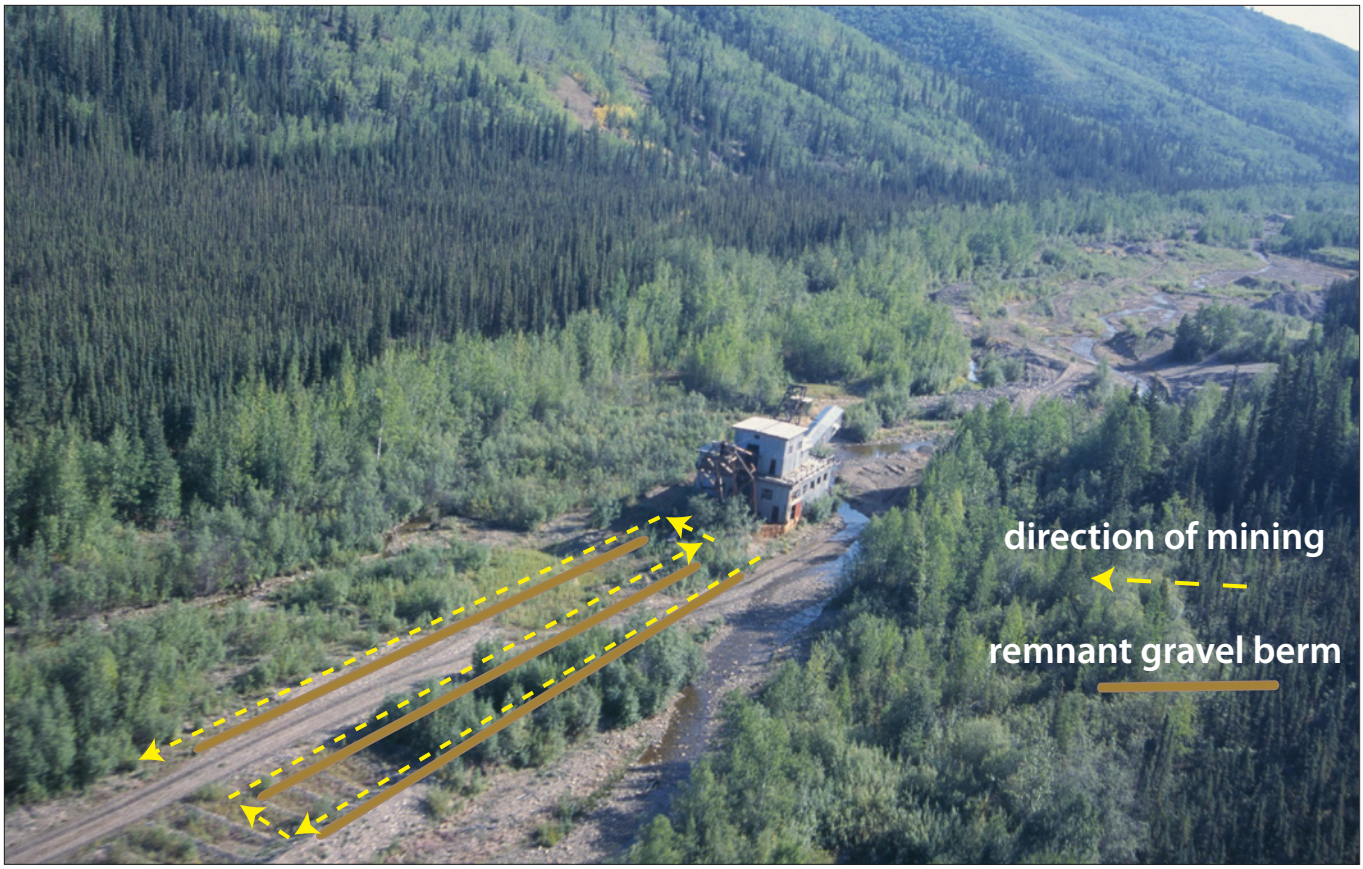

***Figure 8**. Reefs and berms of virgin gravel are often left behind as these barriers are sometimes required to maintain pond integrity. The photo above illustrates how these berms are created during the dredging process.*

***Figure 9**. This photo shows a virgin gravel remnant which was left behind by previous dredge mining. These remnants commonly contain high grades of placer gold worth unearthing from beneath former dredge tailings and settling ponds.*