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Subject: Reach P-2 and P-3 Sediment Investigations

Analytical results from our 1st sediment sampling event in reaches P-2 and P-3 have been received, and will be used to quickly plan a 2nd sampling event (hopefully before Thanksgiving). We only analyzed for Pu in this sampling event because prior sampling upstream and downstream in P-1 and P-4 had identified Pu as the dominant contributor to risk, and because of the relatively large Pu inventory that has been inferred to exist in Pueblo Canyon. A total of 80 Pu analyses were obtained between P-2 and P-3. In the 2nd sampling event we will look for a larger limited suite of analytes in a subset of samples, in addition to further evaluating Pu distribution, concentrations, and inventory.

Reaches P-2 and P-3 were both divided into 2 sub-reaches, and sampling in these 4 areas was designed to evaluate downstream changes in Pu concentration and Pu inventory. P-2 West includes the area of Test Well 2, and is the area where the stream gradient first drops after a relatively steep and narrow reach extending west to P-1. P-2 East is immediately downstream from a tributary off North Mesa (informally called Kwage Canyon), which appeared to be a major source of sediment for lower Pueblo Canyon and is therefore an area where Pu concentrations may drop. P-3 West is upstream from the sewage treatment plant outfall, extending west to Hamilton Bend. P-3 East is downstream of the outfall and includes the site of well PAO-1, and has water at a shallow depth resulting from the effluent releases; the east end of P-3 East is fairly close to P-4, and it was assumed that Pu concentrations would be similar in these two areas.

Pu-239,240 Concentration

Maximum Pu concentrations found so far in all 4 P-2 and P-3 sub-reaches are in relatively fine-grained overbank sediment deposits overlying post-lab channel deposits (c2 and c3 geomorphic units) or floodplains (f1 geomorphic unit). The maximum in P-2 West is 73.4 pCi/g, in P-2 East is 7.1, in P-3 West is 44.9, and in P-3 East is 7.9 pCi/g. The maximums are all less than the highest values found in larger data sets in P-1 and P-4 (~500 and 170 pCi/g, respectively), and in all Pueblo Canyon reaches sediment with >40 pCi/g seem to occur in relatively restricted overbank settings with small volume.

Average Pu concentrations in both channel and overbank deposits appear to decrease between P-2 West and P-2 East, supporting the prior inference that Kwage Canyon is a major sediment source and a point of dilution. In



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particular, average Pu concentrations in the youngest and volumetrically largest overbank deposits in P-2 East, P-3 West, and P-3 East (c2 units) are all between 1 and 2 pCi/g, whereas in P-2 West only 1 overbank sediment sample yielded <2 pCi/g (n = 19). Average Pu concentrations on floodplains (f1 units) also appear to decrease downstream, with the largest drop at Kwage Canyon (av. on floodplains = 7.4 pCi/g in P-2 West, 3.2 in P-2 East, 2.0 in P-3 West, and 1.3 in P-3 East).

The biggest surprise in these data is how low average Pu concentrations seem to be in overbank deposits in P-2 and P-3 in comparison to P-4. Analysis of 19 overbank samples in P-4 that appear to date to the post-1965 period ranged from 1.5 to 18.7 pCi/g, with an average of 6.2 pCi/g, much higher than in the new reaches downstream from Kwage Canyon. There are at least 2 possible explanations for this apparent downstream increase in Pu concentration between P-3 and P-4: (1) P-4 samples may on average be finer-grained, and the apparent increase may thus be an artifact of particle size-Pu relations; (2) Pu may have moved through Pueblo Canyon in a wave-like fashion, and we may have caught the lower concentrations on the "tail" in P-2 and P-3, with the "tail" not yet reaching P-4 or with little sediment from the "tail" being deposited in P-4. Particle size data that we are obtaining on each sample and ongoing efforts to date specific flood layers (using airphotos, tree ring analysis, and historic rainfall data) should help us to evaluate these hypotheses.

Pu-239,240 Inventory

Data obtained in this sampling event supports prior inferences that reach P-4 contains the largest inventory of Pu in the Los Alamos-Pueblo Canyon system (normalized to length of study reach, in units of mCi per km of channel), reflecting deposition and storage of large volumes of Pu-bearing sediment, and that lower inventories are present in upstream reaches. The preliminary estimate of inventory in P-2 West is similar to that estimated upstream in P-1, ~100 mCi/km. Estimated inventories of Pu in P-2 East and P-3 West are similar and are the lowest in Pueblo Canyon, at ~ 50 mCi/km. The estimated inventory increases in P-3 East to ~100 mCi/km, reaching a maximum in P-4 West at ~350-400 mCi/km. In comparison, estimated Pu inventories in the Los Alamos Canyon reaches on DOE land are 3-30 mCi/km and in the reaches on San Ildefonso Pueblo land are 10-20 mCi/km.

The distribution of the total estimated Pu inventory between relatively coarse-grained channel facies sediment and relatively fine-grained overbank facies sediment varies longitudinally along Pueblo Canyon, with a major change occurring at Kwage Canyon. Upstream, in P-1 and P-2 West, an estimated 10-20% of the Pu occurs in channel facies sediment, with the large majority occurring in overbank deposits. In contrast, downstream of

Kwage Canyon in P-2 East, P-3, and P-4, 40-70% of the Pu in each reach is estimated to reside in channel facies deposits. This contrast may be due in part to the input of large volumes of coarse sand from Kwage Canyon, enhancing deposition and storage of channel sediment in the downstream reaches.

As always, please feel free to contact me if you have any questions or if you would like more information, and all input is welcome.

Steve

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