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Preliminary Evaluation of A[illegible]lable Data from Reach LA-[illegible]
S. Reneau, 10/6/97

Analytical data from 40 sediment samples in reach LA-4, on San Ildefonso Pueblo land between Pueblo Canyon and Bayo Canyon, have been received. Thi[illegible] is a complicated reach where sediments from upper Los Alamos Canyon (where the main contaminants of concern include Cs-137, Sr-90, and Am-241) are mixing with sediments from Pueblo Canyon (where Pu-239,240 is the main contaminant of concern). Field radiation measurements indicated that we could detect gamma radiation above background levels (derived from Cs-137), and subdivision of geomorphic units and sampling was in part biased by these measurements. All samples were analyzed for Pu isotopes, Cs-137, and Am-241. Seven sediment samples were also analyzed for Sr-90 and the Target Analyte List (TAL) metals, which were chosen as the stratigraphic layer with the highest field gamma reading in each of 6 depth profiles, plus one younger surface overbank sample adjacent to the active channel. Some selected highlights of the rad data are presented below. Spreadsheets with summaries of the rad data are available for interested parties, and the sample locations and preliminary geomorphic units are shown on FIMAD plots 105901 and 105902.

Maximum Radionuclide Concentrations

Maximum concentrations measured for key radionuclides are 13.8 pCi/g Pu-239,240, 12.8 pCi/g Sr-90, 4.65 pCi/g Cs-137, and 4.64 pCi/g Am-241. The 3 samples with the highest concentrations of Cs-137 (2.82-4.65 pCi/g) are from relatively fine-grained overbank layers that also have the highest concentrations of Am-241 (2.07-4.64) and Pu-238 (0.161-0.227); Pu-239/238 ratios indicate that these layers have little or no Pu-239,240 derived from Pue[illegible]o Canyon and that they were deposited after 1968. Sr-90 is quite puz[illegible]ing: 6 of the 7 analyses are below detection limits, whereas the 7th, at 12.8 pCi/g, is higher than any sample measured upstream in LA-3 (where max =3D 7.3 pCi/g) and also has a higher Sr:Cs ratio (~3) than any sample measured in either LA-3 or LA-2 (where maximum Sr:Cs ratio <1.5). The sole detect for Sr-90 is in a fine-grained overbank layer with the 3rd highest Cs and Am values, consistent with sediments from upper Los Alamos Canyon that were deposited after 1968. The highest concentration measured for Pu-239,240 is from a fine-grained surface sample on an "f2" unit that we thought may have dated from before 1943; this analysis thus indicates dispersion of post-1942 floodwaters over parts of LA-4 in a belt ~25 m wide, wider than we had anticipated. The 2nd highest measurement for Pu-239,240, 9.05 pCi/g, is from a coarse channel deposit at a depth of 68-90 cm that likely represents pre-1965 Pueblo Canyon sediment.

It may be significant that LA-4 was divided into two sub-reaches for purposes of sampling and estimating contaminant inventories (West =3D Basalt Springs to near site of well LA-4; East =3D vicinity of well LA-5 to upstrea=
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of Totavi), and the highest concentrations of each radionuclide were measured in LA-4 West. This suggests that within LA-4 the average concentrations may be decreasing downstream due to dilution within the reach, although we would need more data to test this hypothesis.

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Average Radionuclide Concentrations

Average Pu-239,240 concentrations in the LA-4 overbank deposits range from 0.6 pCi/g for "c1" (youngest overbank deposits, adjacent to modern channel, n =3D 3, range =3D 0.31-0.86 pCi/g) to 5.9 pCi/g for "f2" (relatively high floodplain surface, n =3D 3, range =3D 0.44-13.8 pCi/g). However, there is much overlap in Pu concentrations between the overbank deposits sampled from the different geomorphic units, and there may not be a defensible basis at this point in time for treating them separately. Lumping all the overbank deposits together (except c1, with consistently low values) provides an average of 2.2 =B1 2.8 pCi/g Pu-239,240 (n =3D 27). This is abo= ut
1/3 the average concentration in the younger P-4 overbank deposits and <1/10 the average concentration in the older P-4 overbank deposits, indicating considerable dilution. This is also about 3x the average concentrations measured in overbank sediments in LA-5, indicating the magnitude of dilution occurring between LA-4 and the Rio Grande.

Average Pu-239,240 concentrations in the younger LA-4 channel deposits (0.06 pCi/g for "c1" and 0.2 pCi/g for "c2" are 1/5 to 1/20 the average concentrations in the younger P-4 channel deposits. Pu-239,240 concentrations in the older LA-4 channel deposits (unit "c3") are significantly higher, averaging 5.1 pCi/g (n =3D 4, range =3D 2.13-9.05). T= his
is about 70% of the average concentration for the older (pre-1965) P-4 channel deposits, and suggests that the c3 channel deposits in LA-4 date to before 1965 and represent sediment largely derived from Pueblo Canyon.

Average Cs-137 concentrations in the LA-4 overbank deposits range from 0.65 pCi/g for "f2" to 2.15 pCi/g for "c2". As with Pu-239,240, there is much overlap between values from each of the units (except again the "c1" overbank deposits are relatively low, average =3D 0.72 pCi/g), and lumping overbank deposits from c2, c3, f1, and f2 yields an average of 1.16 =B1 1.07 pCi/g. This is about 1/3 the average concentration in the relatively young "c2" overbank deposits in LA-3 and about 1/7 the average concentration in the "c3" overbank deposits in LA-3, indicating considerable dilution.

Average Cs-137 concentrations are identical in the young LA-4 channel deposits (c1 + c2, average of each =3D 0.048 pCi/g), and significantly highe= r
in the older c3 channel deposits (average =3D 0.34 pCi/g). The c1 + c2 values are only 1/20 the average value obtained upstream in the active channel in LA-3, and the c3 values are 1/7-1/10 the average values in the older LA-3 channel deposits, again showing much dilution.

Preliminary Cs-137 and Pu-239,240 Inventory

Preliminary inventories of Cs-137 and Pu-239,240 have been prepared to allow comparison with upstream and downstream reaches. Estimates were made using both average concentrations for combined overbank deposits from the c2, c3, f1, and f2 units, and also using only the data from each of the original mapping units. For both Cs and Pu, these alternatives resulted in <10% difference in estimated inventory, although the relative portions in

the different units changed. For now, I am using the estimates from combining the c2 thru f2 overbank deposits.

The preliminary estimate of Pu-239,240 inventory in LA-4 is about 14 mCi/km, which is <10% that estimated in P-4 and almost identical to that estimated in LA-5 (~13 mCi/km). These estimates thus support the earlier inferences that the largest amount of Pu in the Los Alamos-Pueblo Canyon system is contained within the sediments of Pueblo Canyon, and indicate that similar inventories of Pu exist in different parts of lower Los Alamos Canyon (the decreasing concentrations offset by increases in the volume of young sediment progressing downstream).

The preliminary estimate of Cs-137 inventory in LA-4 is about 6 mCi/km, about 40% that estimated upstream in LA-3 and <10% that estimated in LA-2 immediately downstream from DP Canyon. As with Pu, the largest amount of Cs in the Los Alamos Canyon system appears to be stored on Laboratory land. Notably, the amount estimated to be stored in LA-4 is similar to that estimated in LA-2 upstream of DP Canyon (~5 mCi/km), where the Cs may largely be derived from reworking of atmospheric fallout.

About 65% of the estimated Pu inventory is contained within the overbank sediments, and 35% within channel deposits. In contrast, about 80% of the estimated Cs inventory is contained within the overbank sediments, and only 20% within channel deposits. These differences are consistent with what has been found upstream in P-4 and LA-3, with channel sediments being more important as storage sites for Pu in Pueblo Canyon than for Cs in upper Los Alamos Canyon, although overbank deposits seem to be more important storage sites for Pu in LA-4 than in P-4 (overbank deposits are also the most important storage site for Pu in LA-5).

Utility of Field Gamma Measurements

We had mixed success with using the field gamma measurements to help define geomorphic units based on inferred Cs-137 concentrations and to target specific layers with the highest Cs concentrations in select profiles for analysis of Sr-90 and TAL metals. In the sampled profiles, the sediment layer with the highest Cs-137 concentration was measured in the layer with the highest field gamma measurements in 5 out of 7 cases, indicating that these measurements are generally useful but not infallible in deposits with relatively low concentrations of Cs (a common lack of correspondence between highest gamma and highest Cs was also found in reach LA-3). However, the 2 highest Cs concentrations (4.65 and 3.45 pCi/g) were measured in a "c2" unit where the field measurements had indicated relatively low gamma radiation (the layer with the highest field gamma measurement had the 3rd highest Cs concentration, 2.82 pCi/g). The field gamma measurements are thus not reliable indicators of Cs concentration at such low levels, and revision to the geomorphic units, originally biased by the gamma measurements, will thus be required.

Some Issues to Address in Second Sampling Event

This preliminary examination of the LA-4 data suggest some topics requiring

ıdditional data in a 2nd sampling event.

: Sr-90. The sole detect, at 12.8 pCi/g, is quite anomalous, and should be :onfirmed with a replicate analysis from this layer. Additional Sr-90 ınalyses from other sample locations may also be warranted.

: The vertical and horizontal extent of Pu-239,240 on the "f2" unit, where :he highest concentration was obtained, is poorly defined, and should be ıddressed with additional sampling on these floodplains.

: The available data suggest a possible decrease in average concentrations ›f Cs and Pu in the 1 km between the mid-points of LA-4 West and LA-4 East. ıdditional data from representative units in each sub-reach could reveal .f this apparent trend is accurate or if instead it is an artifact of ;ample site selection.

:n addition, some revision to the geomorphic mapping will be required based ›n the results from the 1st sampling event, such that the units more ıppropriately reflect the variations in contaminant concentrations that ıave been identified.

?lease feel free to contact me for any reason.

MESSAGE SCAN FOR JOHN YOUNG

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From: (Steven Reneau) sreneau@lanl.gov:smtp
Postmark: Oct 06,97 7:13 PM Delivered: Oct 06,97 7:13 PM

Subject: Reach LA-4 Sediment Investigations

Comments:
See document for message.

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