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MOFFETT FIELD
SSIC NO. 5090.3.A

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May 6, 1998

Mr. Stephen Chao
Department of the Navy
Engineering Field Activity West
Naval Facilities Engineering Command
900 Commodore Drive, Building 210
San Bruno, California 94066-5006

CLEAN Contract Number N62474-94-D-7609
Contract Task Order 153

Subject: **Preliminary In Situ Abiotic Redox Manipulation (ISRM) Phase I Soil Reduction Test Results**

Dear Stephen:

Enclosed are plots of preliminary results obtained during the soil reduction portion of the ISRM batch tests. These results indicate the extents to which sodium dithionite in a reducing solution reacted with available Fe(III) in soils collected from the proposed test area, as well as the rates at which dithionite disproportionation occurred during testing. Based on previous studies by Pacific Northwest National Laboratory (PNNL), dithionite dissociates into sulfoxyl radicals, which react with iron relatively quickly (in approximately 4 to 5 hours). The disproportionation reactions occur more slowly, but continuously throughout the period in which reducing solution is in contact with soils. As you can see from the plotted data, the dithionite concentrations measured for each series of replicates during Phase I testing decreased rapidly within the initial 300 to 400 minutes of the test period. Flattening of the concentration curves after this time signifies that disproportionation reactions began to predominate and that the available iron had been expended.

Based on extrapolation of the disproportionation portion of the concentration curves to zero, and subtraction of this value from the initial concentrations used for each series of replicates (as shown on the figures), the amount of dithionite that reacted with Fe(III) ranged from approximately 5,100 to 6,800 parts per million (ppm). These values correlate to quantities of available Fe(III) ranging from 0.8 to 1.1 weight percent in the soils tested. These results compare well with the amount of available iron (approximately 1 weight percent) determined by dithionite citrate extraction analysis (this analytical method employs dithionite but is unrelated to the reduction test method).

The amounts of available iron determined during testing are significantly higher than the criterion presented by PNNL of a minimum 0.05 weight percent, indicating that MFA soils may be highly amenable to dithionite reduction. Sediment recovery during Phase I field activities, however, was uneven. Sediments recovered from the channel interval (and used in the batch tests) may represent the finer-grained portion of the channel package. Drilling

contains recycled fiber and is recyclable

characteristics observed through intervals with no sample recovery indicate coarser sediments are likely to exist at the proposed ISRM Phase II site. Because the batch test soils contained likely higher clay content than typical channel deposit sediments, these available iron contents may be overly optimistic indicators of the potential reducing capacity of the channel deposits. Subsequent analysis activities will involve comparison of test soil composition to that of typical MFA channel deposit sediments, as well as dithionite citrate extraction analysis of channel deposit samples obtained during unrelated field activities, to assess the relative potential quantities of available Fe(III) in typical channel deposits.

These results are preliminary and are intended primarily as an informational status update. Much additional work will be required to fully analyze the data. The Phase I test report will discuss specific issues associated with the data and the test methodologies used for both the iron reduction and subsequent volatile organic compound (VOC) degradation portions of Phase I batch testing.

Following some additional laboratory setup activities and preliminary testing, the VOC degradation portion of Phase I will be underway. Please call me at (303) 312-8845 with any questions regarding the preliminary results or test activities.

Sincerely,

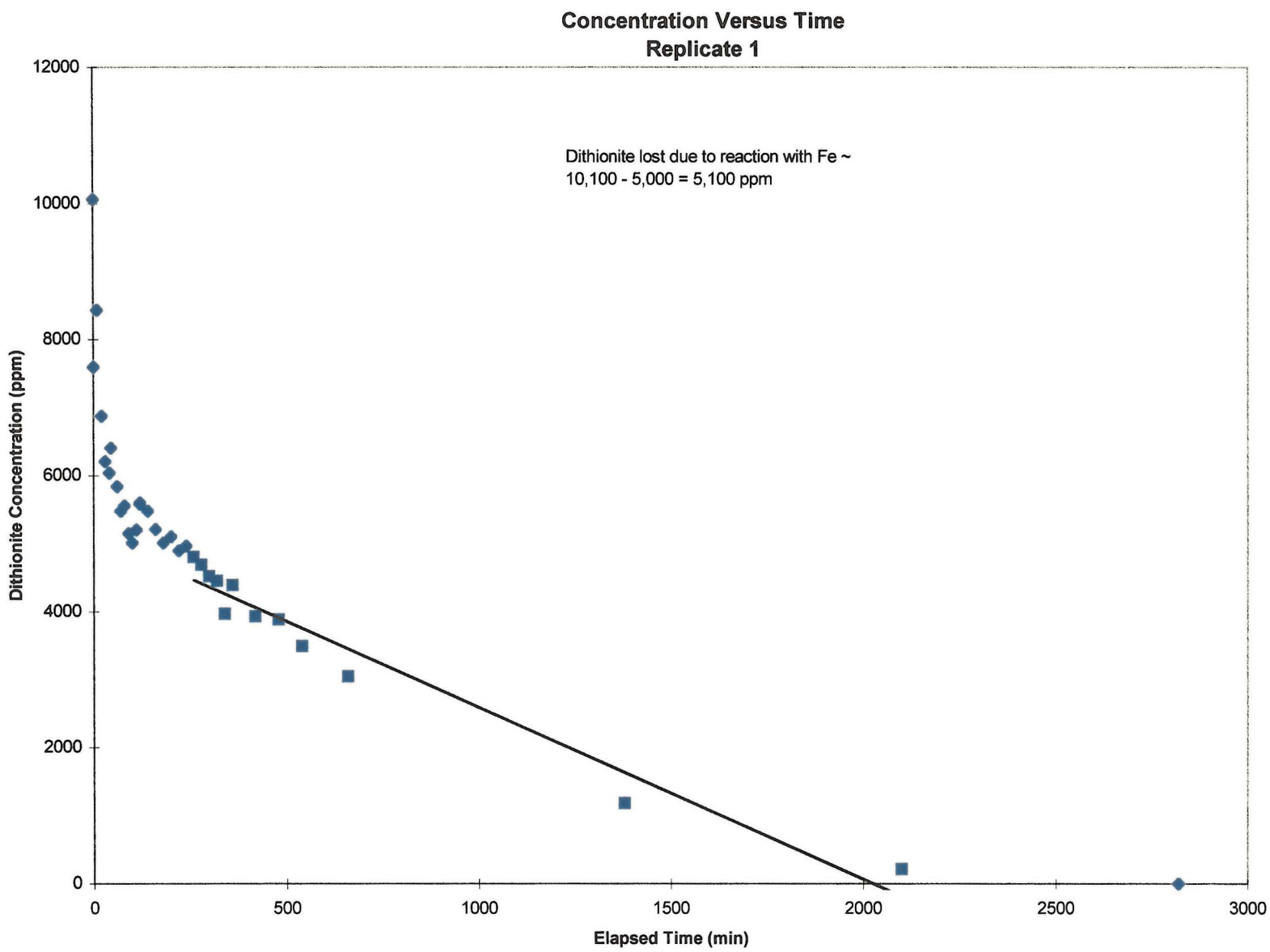
Ronna T. Ungs

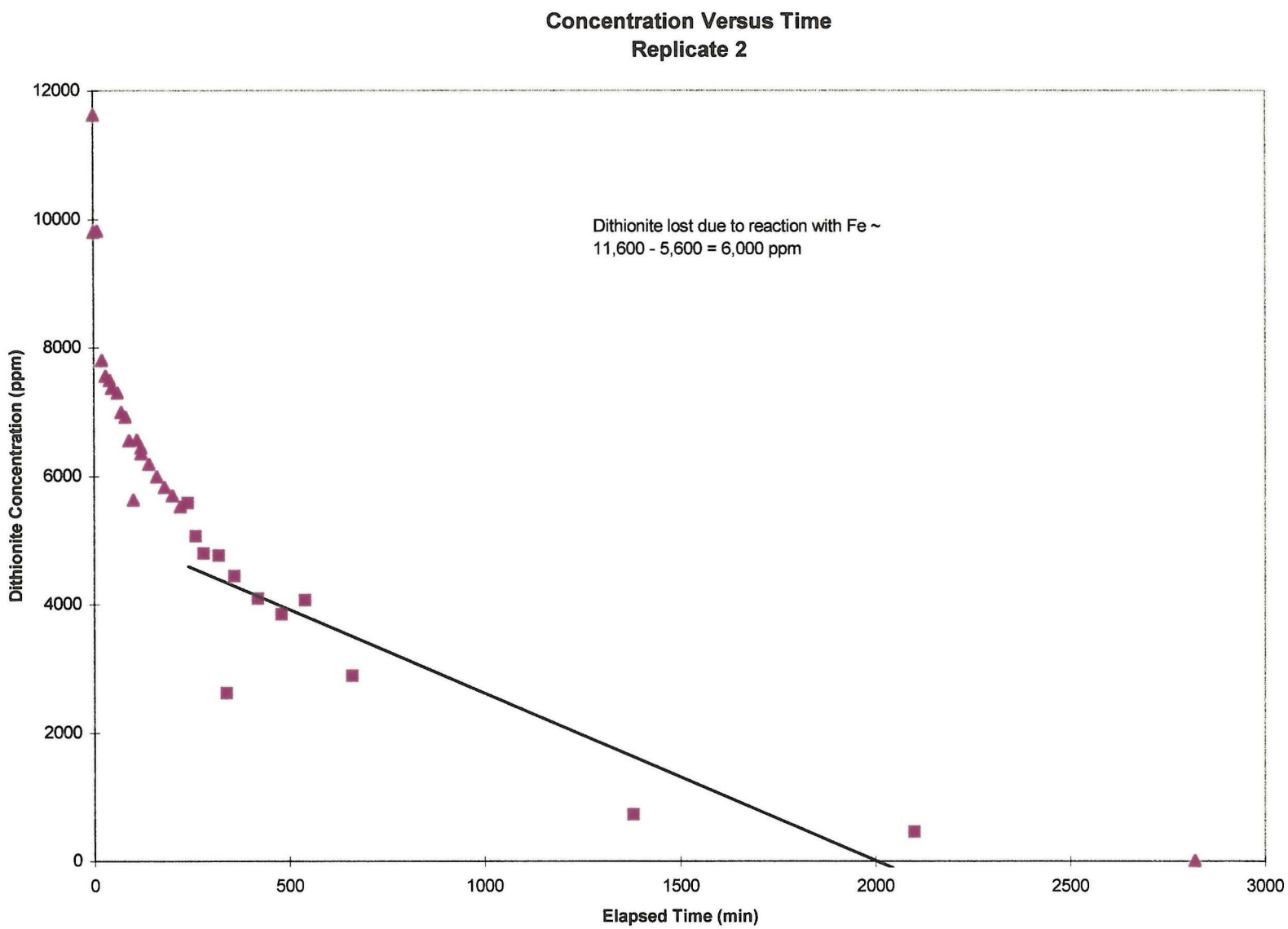
Ronna T. Ungs
Project Engineer

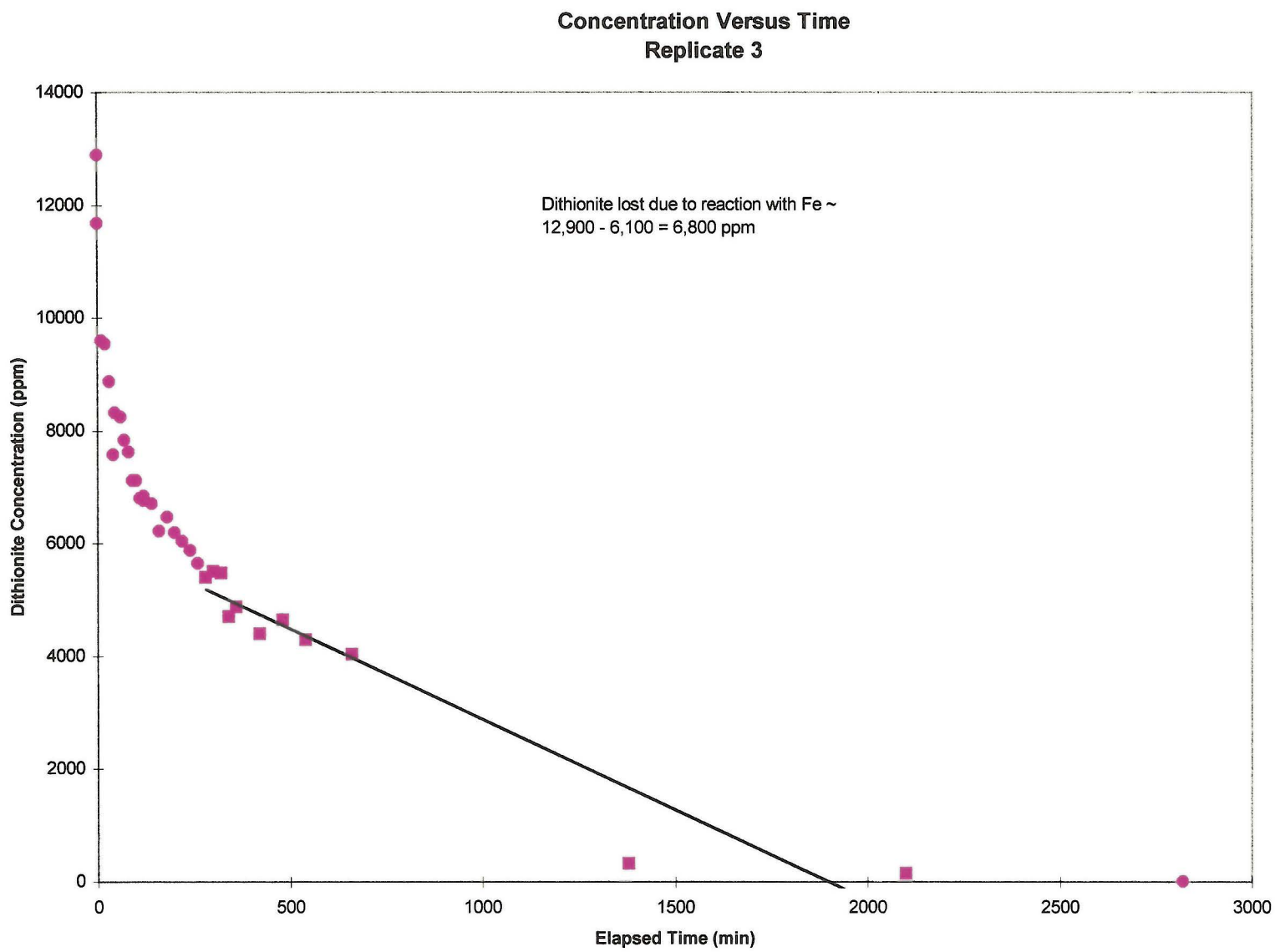
cc: Mr. Donald Chuck (EFA West)
Mr. Chuck Reeter (NFESC)

RTU/jed

Enclosure


Concentration Versus Time
Replicate 1
Dithionite lost due to reaction with Fe ~
10,100 - 5,000 = 5,100 ppm
Dithionite Concentration (ppm)
12000
10000
8000
6000
4000
2000
0
0
500
1000
1500
2000
2500
3000
Elapsed Time (min)


Concentration Versus Time
Replicate 2
Dithionite lost due to reaction with Fe ~
11,600 - 5,600 = 6,000 ppm
Dithionite Concentration (ppm)
Elapsed Time (min)
12000
10000
8000
6000
4000
2000
0
0
500
1000
1500
2000
2500
3000


Concentration Versus Time
Replicate 3
Dithionite lost due to reaction with Fe ~
12,900 - 6,100 = 6,800 ppm
Dithionite Concentration (ppm)
Elapsed Time (min)
14000
12000
10000
8000
6000
4000
2000
0
0
500
1000
1500
2000
2500
3000

Calculations

All concentrations measured during testing were based on ppm (mg/L) of sodium dithionite ($Na_2S_2O_4$).

Replicate 1:

Dithionite lost due to reaction with Fe(III) ~5,100 ppm

(5100 mg/L $Na_2S_2O_4$) x (L/1000ml) x (10 ml/sample) x (g/1000mg) x (1 gmol/174g $Na_2S_2O_4$)
= 0.00029 gmol $Na_2S_2O_4$ reacted

(0.00029 gmol $Na_2S_2O_4$) x (2 gmol Fe/gmol $Na_2S_2O_4$) x (56 g Fe/gmol Fe)
= 0.033 g Fe reacted/sample

(0.033 g Fe/sample)/(4 g/sample) x 100%

= 0.8 weight percent Fe reacted

Replicate 2:

Dithionite lost due to reaction with Fe(III) ~ 6,000 ppm

(6000 mg/L $Na_2S_2O_4$) x (L/1000ml) x (10 ml/sample) x (g/1000mg) x (1 gmol/174g $Na_2S_2O_4$)
= 0.0003 gmol $Na_2S_2O_4$ reacted

(0.00034 gmol $Na_2S_2O_4$) x (2 gmol Fe/gmol $Na_2S_2O_4$) x (56 g Fe/gmol Fe)
= 0.039 g Fe reacted/sample

(0.039 g Fe/sample)/(4 g/sample) x 100%

= 1 weight percent Fe reacted

Replicate 3:

Dithionite lost due to reaction with Fe(III) ~ 7,200 ppm

(6,800 mg/L $Na_2S_2O_4$) x (L/1000ml) x (10 ml/sample) x (g/1000mg) x (1 gmol/174g $Na_2S_2O_4$)
= 0.0004 gmol $Na_2S_2O_4$ reacted

(0.0004 gmol $Na_2S_2O_4$) x (2 gmol Fe/gmol $Na_2S_2O_4$) x (56 g Fe/gmol Fe)
= 0.044 g Fe reacted/sample

(0.044 g Fe/sample)/(4 g/sample) x 100%

= 1.1 weight percent Fe reacted