Chapter 6. Estimation of vertical hydraulic conductivity given best estimate heterogeneous coal.

I. Introduction

As was demonstrated in chapter 5, the inclusion of some degree of heterogeneity in the coal improves the calibration of the model. However, using estimates of KV from models constructed with homogeneous coal yielded budget discrepancies and sand lens residuals which were relatively high. Estimation of KV, given heterogeneous coal, should result in lower budget discrepancies and sand lens residuals.

II. Method

The procedure for finding the best-fit KV for the heterogeneous coal layer paralleled the procedure for finding the best fit KV for the homogeneous coal layer. The procedure included testing a grid of plausible KV values in one, two, and three zones. The coal K array used in these simulations was the array conditionally simulated from 16 points.

III. Results

One KV zone

Results of these simulations are shown in figures 6-1 and 6-2, and in table 6-1. The best fit for this scenario occurs with a KV of 9E-6 feet/day, and results in a root mean squared error of 19.6 feet, a budget discrepancy of –0.80%, and a mean sand lens residual of 16.1 feet. The heads calculated in this case for layers 1 and 2 are shown in figures 6-3 and 6-4.

Two KV zones

Results of these simulations are shown in figures 6-5 to 6-7, and in table 6-2. The best fit for this scenario occurs with a KV of zone 1 equal to 1E-6 feet/day and a KV of zone 2 equal to 1.25E-5 feet/day. These values result in a root mean squared error of 19.4 feet, a budget discrepancy of –0.73%, and a mean sand lens residual of 13.4 feet.

Three KV zones

Results of these simulations are shown in figures 6-8 to 6-10, and in table 6-3. The best fit for this scenario occurs with a zone 1 KV of 1E-6 feet/day, a zone 2 KV of 1.25E-5 feet/day,

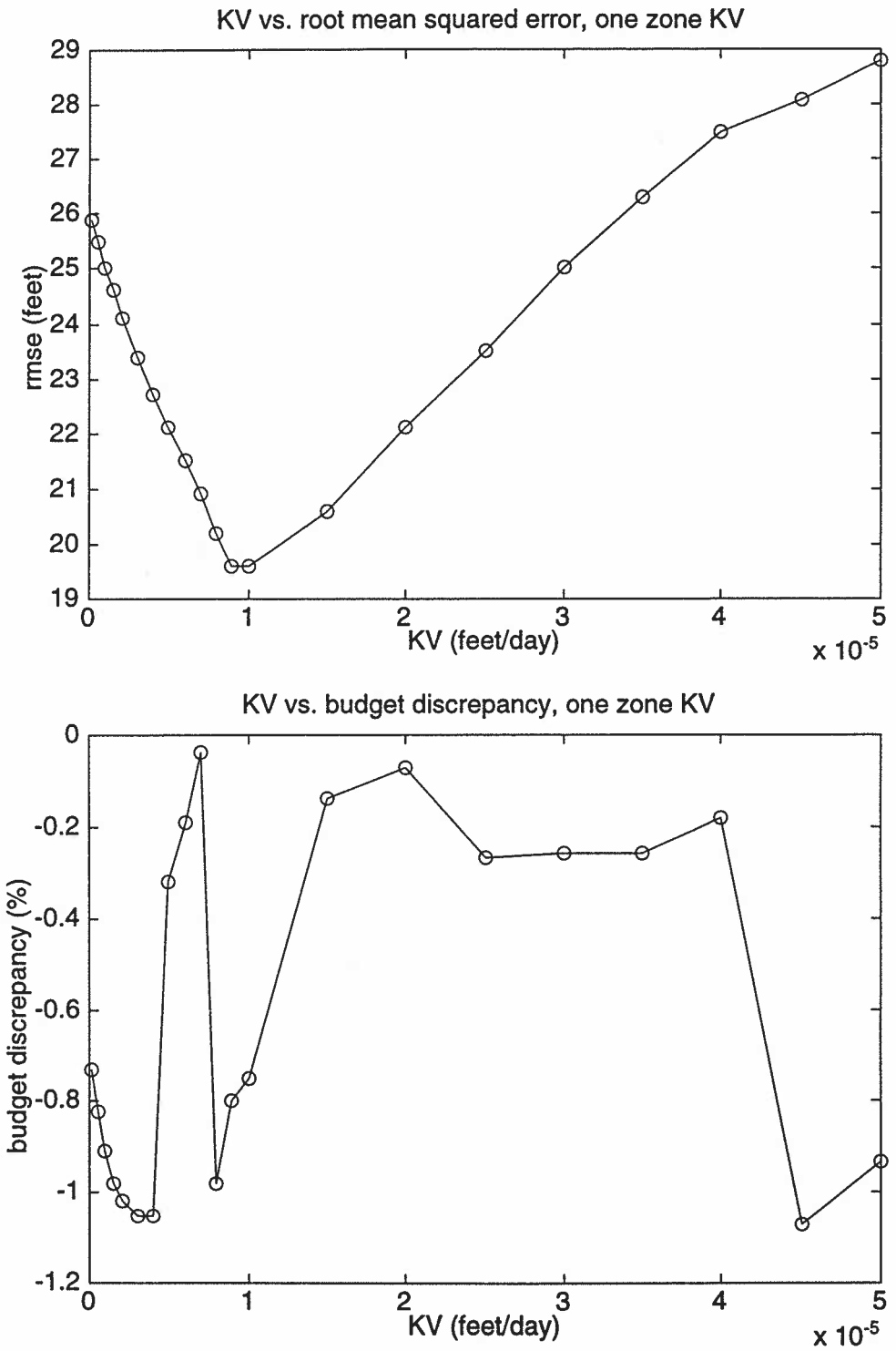

Figure 6-1. KV vs. rmse (root mean squared error) and budget discrepancy. KV is in one zone only, and the coal is heterogeneous.

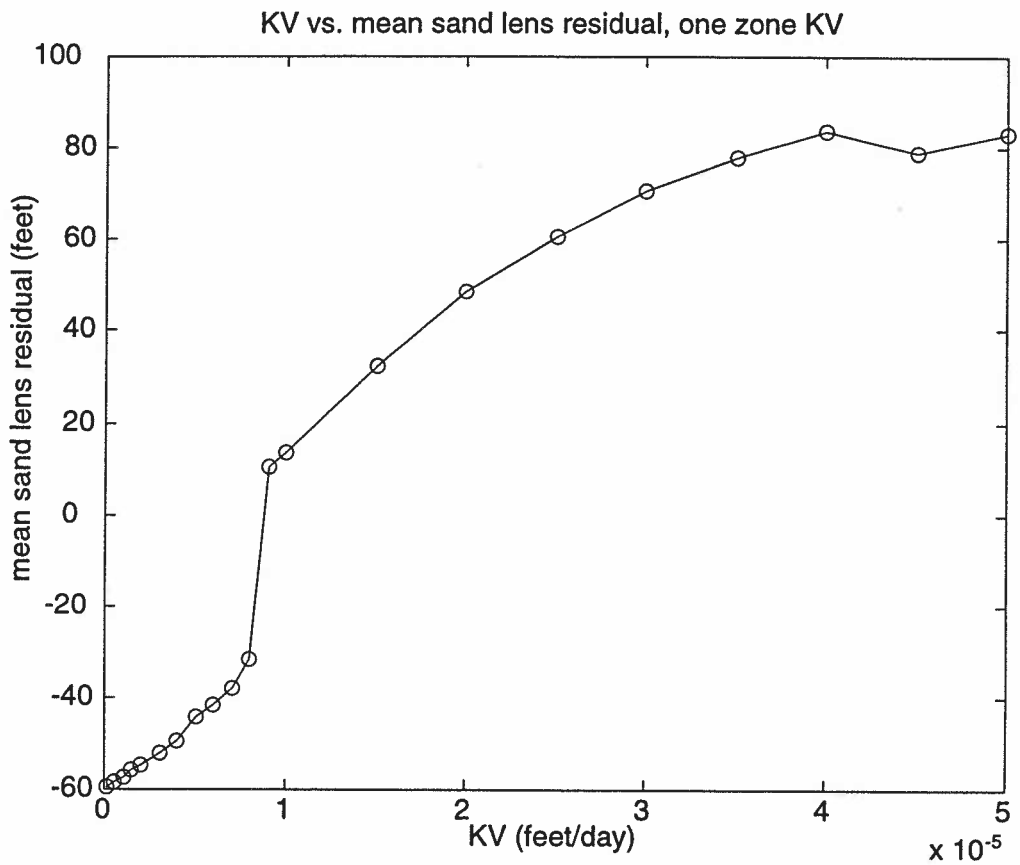

Figure 6-2. KV vs. mean sand lens residual. KV is in one zone and the coal is heterogeneous.

Table 6-1. Results from KV estimation, one zone

CH=4160, heterogeneous coal

simulation no.	KV zone 1 (feet/day)	sum of the squared residuals	mean residual (feet)	budget discrepancy (%)	sand lens resid. #1	sand lens resid. #2	rmse (feet)
1	5.00E-05	33074	-5.58	-0.93	81.5	74.2	28.8
2	4.50E-05	31565	-5.27	-1.07	78.6	71.1	28.1
3	4.00E-05	30278	-3.12	-0.18	85.9	76.2	27.5
4	3.50E-05	27768	-2.51	-0.26	81.3	71.7	26.3
5	3.00E-05	25042	-1.94	-0.26	75.0	65.5	25.0
6	2.50E-05	22066	-1.38	-0.27	66.6	57.3	23.5
7	2.00E-05	19530	-0.91	-0.07	55.9	46.5	22.1
8	1.50E-05	16899	-0.37	-0.14	41.7	31.8	20.6
9	1.00E-05	15363	0.14	-0.75	24.9	13.9	19.6
10	9.00E-06	15407	0.28	-0.80	21.7	10.5	19.6
11	8.00E-06	16294	-0.77	-0.98	-21.3	-32.1	20.2
12	7.00E-06	17502	-0.17	-0.04	-27.4	-39.0	20.9
13	6.00E-06	18447	0.00	-0.19	-30.0	-42.9	21.5
14	5.00E-06	19504	0.22	-0.32	-32.6	-46.6	22.1
15	4.00E-06	20594	0.22	-1.05	-35.5	-52.2	22.7
16	3.00E-06	21857	0.63	-1.05	-38.0	-55.5	23.4
17	2.00E-06	23298	1.17	-1.02	-40.6	-58.9	24.1
18	1.50E-06	24111	1.50	-0.98	-42.1	-60.6	24.6
19	1.00E-06	25005	1.87	-0.91	-43.6	-62.3	25.0
20	5.00E-07	26004	2.29	-0.82	-45.3	-64.1	25.5
21	1.00E-07	26898	2.67	-0.73	-46.7	-65.5	25.9

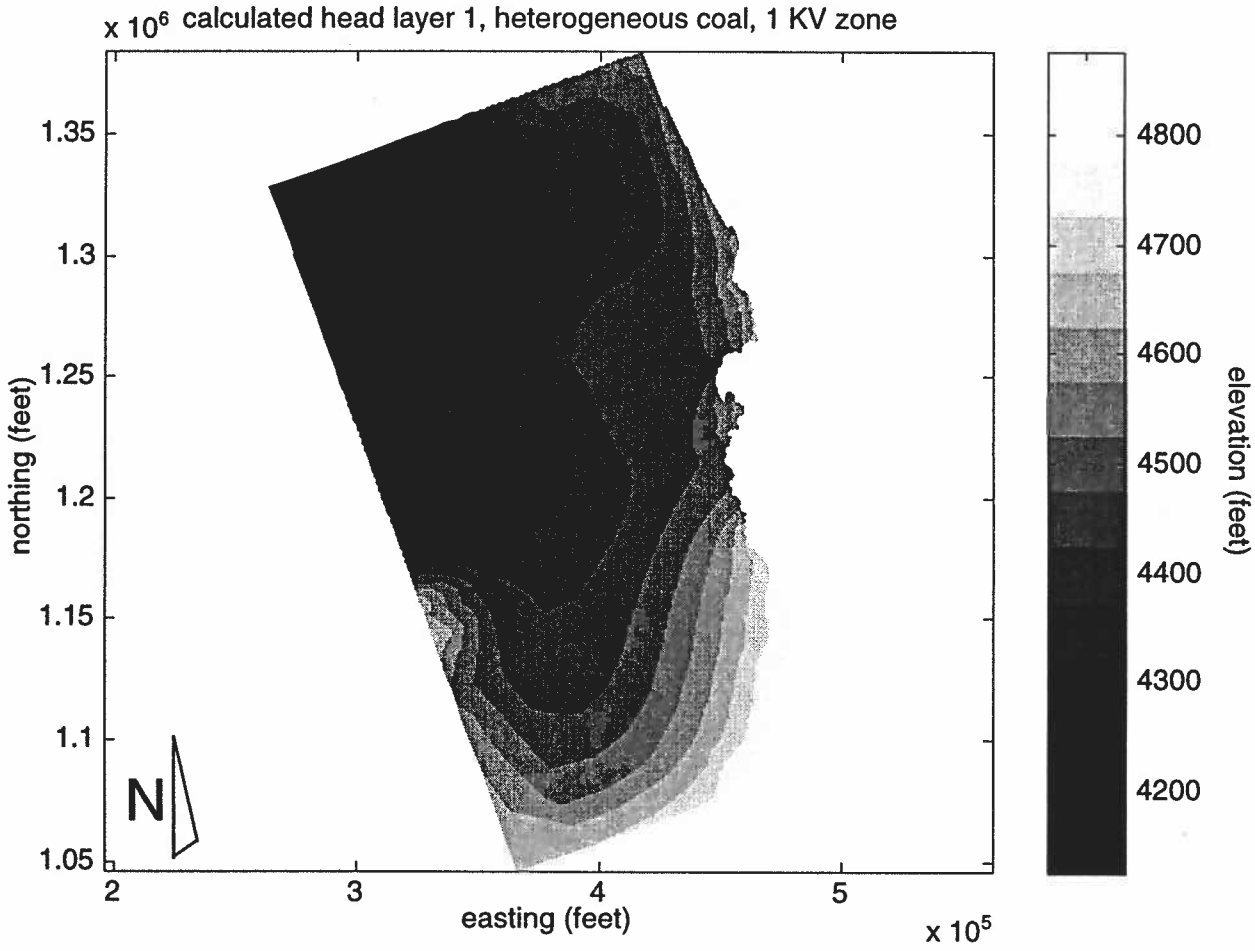

Figure 6-3. Head in layer 1 calculated with heterogeneous coal; heterogeneous coal, heterogeneous transition zone, non-clinker cropline cells inactive, KV = 9.0E-06 feet/day. Coal K array conditionally simulated with 16 conditioning points.

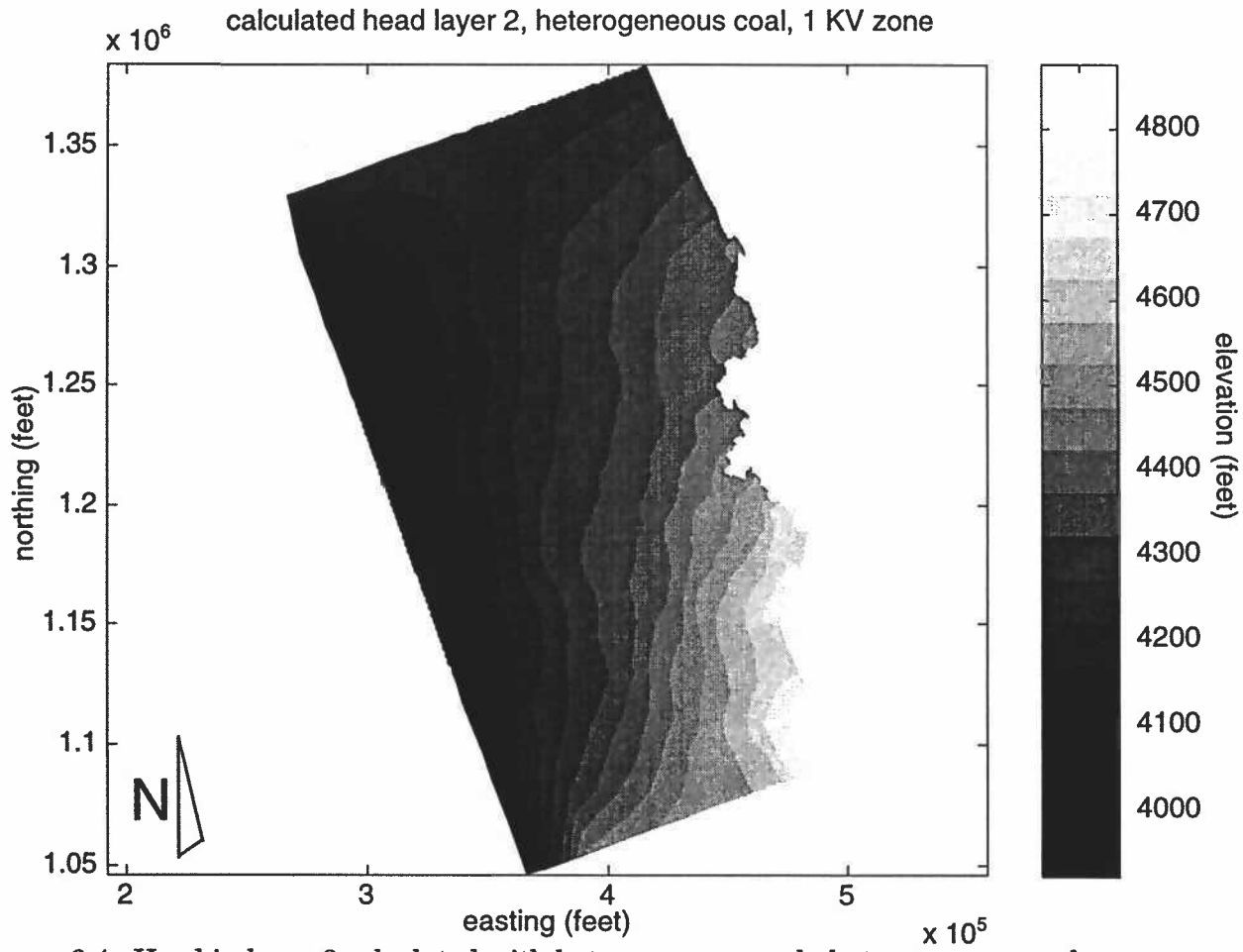

Figure 6-4. Head in layer 2 calculated with heterogeneous coal; heterogeneous coal, heterogeneous transition zone, non-clinker cropline cells inactive, KV = 9.0E-06 feet/day. Coal K array conditionally simulated with 16 conditioning points.

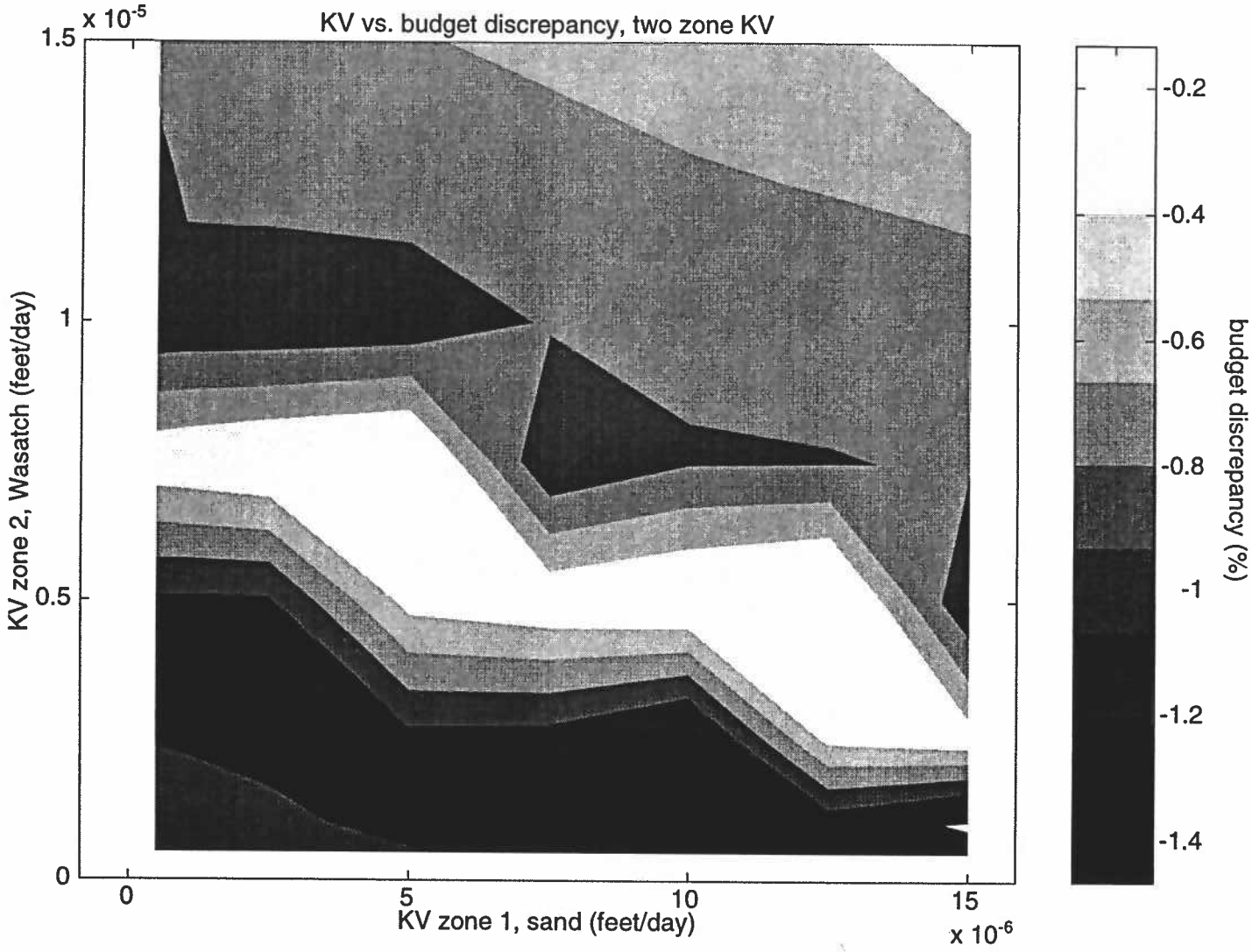

Figure 6-5. Topography of the solution, in terms of budget discrepancy, for the estimation of KV in two zones with heterogeneous coal.