DR2005014

GSA METHODS AND DATA REPOSITORY

RH: A long-lived glaciation in the Late Ordovician?

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All isotopic results from carbonates and organic matter are tabulated in the attached GSA Data Repository, and included along with figures plotting carbonate $\delta^{13}C$ and $\delta^{18}O$ and the stratigraphic position of $\delta^{18}O$ values. Thin and polished thick sections were prepared from all samples. Standard techniques for diagenetic screening including petrographic analysis of thin sections and thick section examination under cathodoluminescence were employed. We used a microscope-mounted drill assembly and 1 mm drill bits as a way to easily obtain carbonate powder from petrographically "least altered" areas of polished thick sections. Homogeneous micrites with uniform luminescence on the scale of drilling were the preferred component, although many of the sampled phases (~1 mg of powder) isolated had a coarser-grained component that was recrystallized to various degrees. In general, no evidence of obvious non-marine diagenetic textures was observed in petrographic study of selected samples. All samples are dominantly limestone, with dolomite accounting for less than 5% of rock component in thin sections examined. Field investigation did not show evidence of major exposure surfaces, and only the Copenhagen-Eureka contact may potentially represent an unconformable surface subject to large scale fluid movement. However, the topmost samples from the Copenhagen examined did not show evidence of meteoric diagenetic fabrics such as zoned cements.

Carbonate powders drilled from fresh rock surfaces in this study were roasted under vacuum at 380° C for one hour to remove volatile contaminants and reacted with 100%

phosphoric acid at 75° in an online carbonate preparation line (Carbo-Kiel – single sample acid bath) connected to a Finnigan Mat 252 or 251 mass spectrometer. The analytical precision based on duplicate analyses and on multiple analyses of NBS19 was ≤ 0.04‰. Samples for $\delta^{13}C_{org}$ were reacted completely with HCl and rinsed five times to insure complete removal of carbonate, and then converted to carbon dioxide gas using a combustion furnace attached to a continuous flow isotope ratio mass spectrometer.

TABLE DR1. Late Ordovician, NEVADA

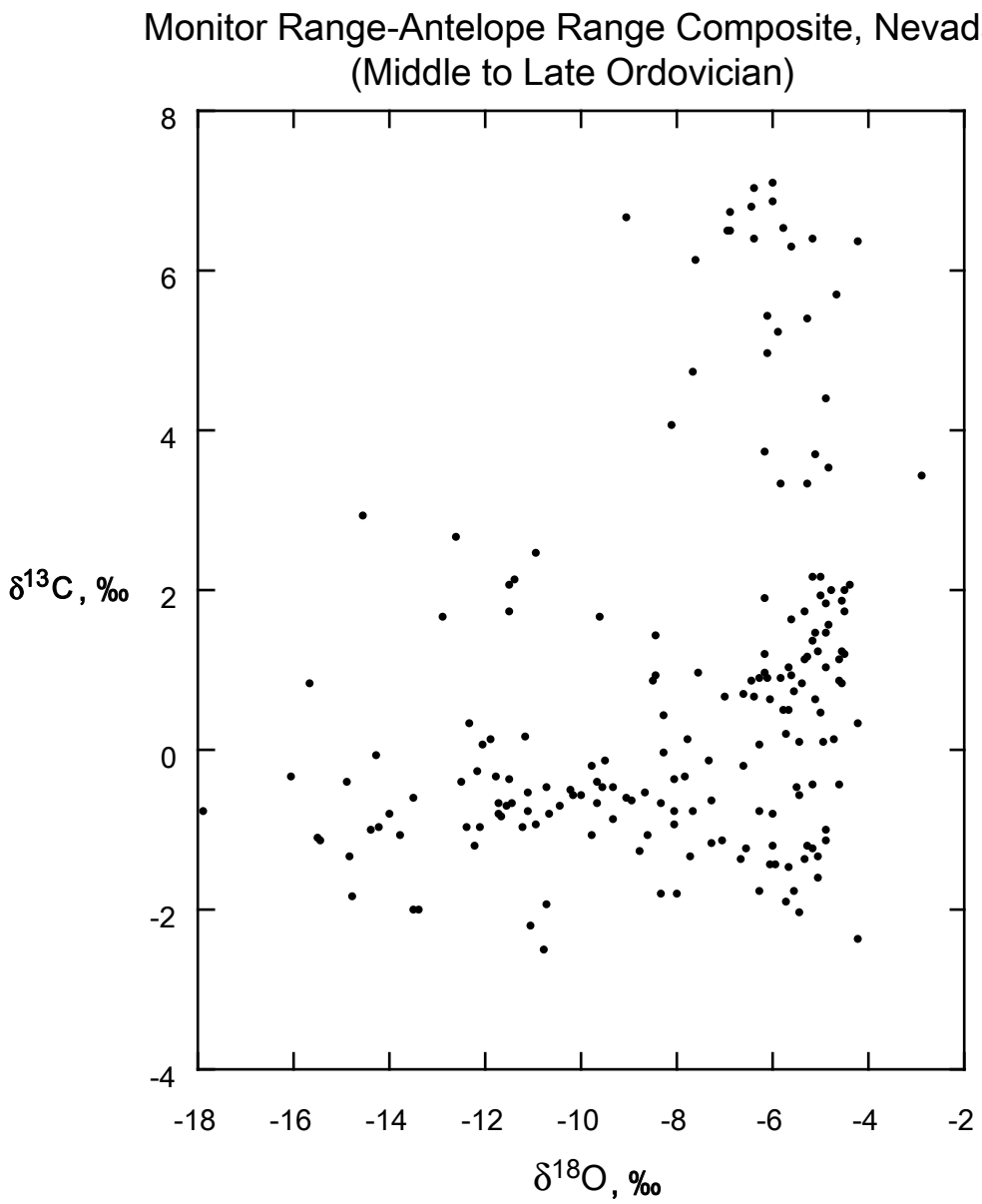
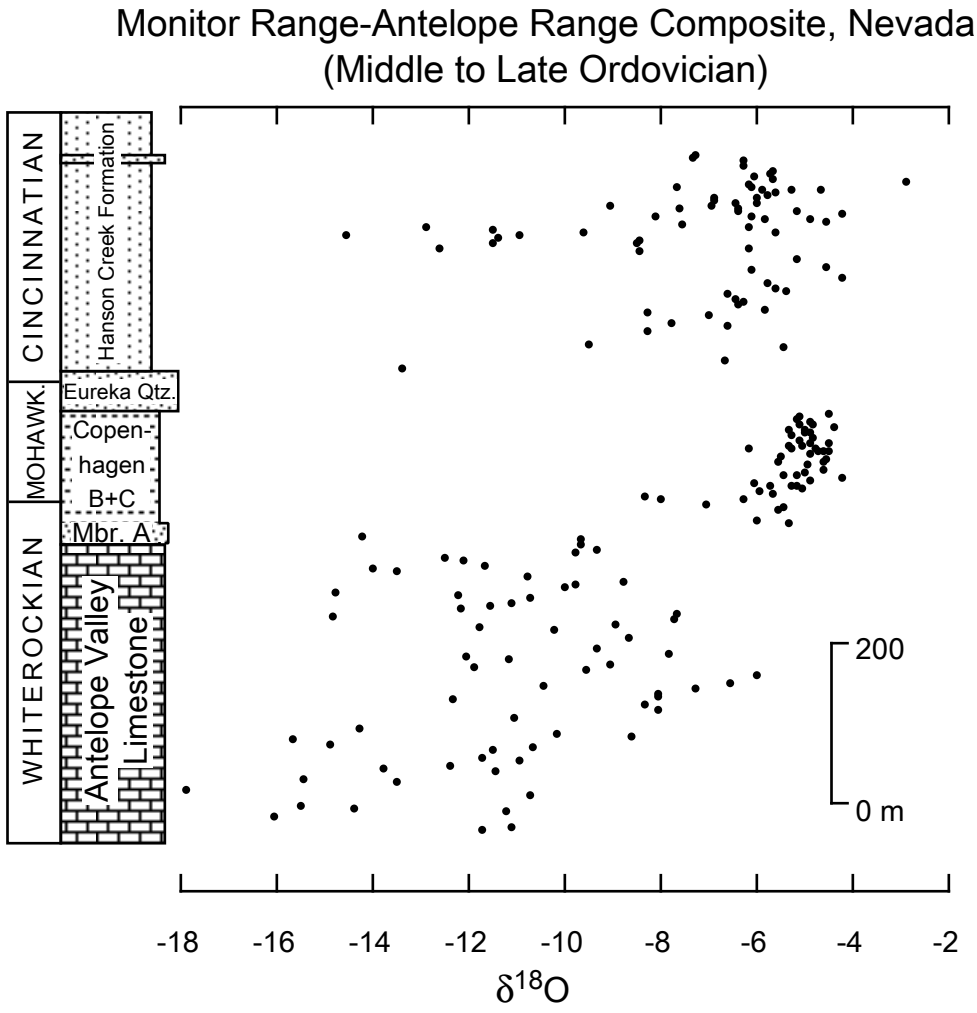
Meters	δ13Ccarb	δ18O	δ13Corg	Formation	Sample Lithology	Author
0	-0.79	-11.72		Antelope Valley Limestone	wackestone	this study
4.5	-0.78	-11.13		Antelope Valley Limestone	wackestone	this study
18	-0.32	-16.07		Antelope Valley Limestone	wackestone	this study
22.5	-0.98	-11.23		Antelope Valley Limestone	wackestone	this study
27	-0.99	-14.41		Antelope Valley Limestone	wackestone	this study
31.5	-1.11	-15.53		Antelope Valley Limestone	wackestone	this study
45	-1.94	-10.76		Antelope Valley Limestone	wackestone	this study
49.5	-0.77	-17.92		Antelope Valley Limestone	wackestone	this study
58.5	-0.59	-13.51		Antelope Valley Limestone	wackestone	this study
63	-1.13	-15.48		Antelope Valley Limestone	wackestone	this study
72	-0.67	-11.47		Antelope Valley Limestone	packstone	this study
76.5	-1.05	-13.80		Antelope Valley Limestone	lime mudstone	this study
81	-0.97	-12.43		Antelope Valley Limestone	lime mudstone	this study
85.5	-0.92	-10.98		Antelope Valley Limestone	lime mudstone	this study
90	-0.68	-11.73		Antelope Valley Limestone	lime mudstone	this study
99	-0.37	-11.54		Antelope Valley Limestone	lime mudstone	this study
103.5	-0.81	-10.68		Antelope Valley Limestone	lime mudstone	this study
108	-0.39	-14.89		Antelope Valley Limestone	lime mudstone	this study
112.5	0.82	-15.69		Antelope Valley Limestone	lime mudstone	this study
117	-1.05	-8.62		Antelope Valley Limestone	lime mudstone	this study
121.5	-0.58	-10.21		Antelope Valley Limestone	packstone	this study
126	-0.05	-14.29		Antelope Valley Limestone	packstone	this study
139.5	-2.19	-11.05		Antelope Valley Limestone	packstone	this study
148.5	-0.92	-8.08		Antelope Valley Limestone	packstone	this study
157.5	-0.67	-8.34		Antelope Valley Limestone	packstone	this study
162	0.33	-12.34		Antelope Valley Limestone	wackestone	this study
166.5	-0.77	-8.05		Antelope Valley Limestone	wackestone	this study
171	-0.35	-8.07		Antelope Valley Limestone	wackestone	this study
175.5	-0.63	-7.31		Antelope Valley Limestone	wackestone	this study
180	-0.71	-10.45		Antelope Valley Limestone	packstone	this study
184.5	-1.23	-6.56		Antelope Valley Limestone	lime mudstone	this study
194.5	-0.79	-6.01		Antelope Valley Limestone	lime mudstone	this study
199	-0.48	-9.60		Antelope Valley Limestone	lime mudstone	this study
203.5	0.12	-11.91		Antelope Valley Limestone	wackestone	this study
208	-0.59	-9.08		Antelope Valley Limestone	wackestone	this study
212.5	0.16	-11.16		Antelope Valley Limestone	wackestone	this study
217	0.08	-12.10		Antelope Valley Limestone	wackestone	this study
221.5	-0.32	-7.84		Antelope Valley Limestone	packstone	this study
226	-0.45	-9.37		Antelope Valley Limestone	packstone	this study
239.5	-0.53	-8.67		Antelope Valley Limestone	lime mudstone	this study
248.5	-0.51	-10.22		Antelope Valley Limestone	lime mudstone	this study
253	-0.33	-11.79		Antelope Valley Limestone	wackestone	this study
257.5	-0.62	-8.97		Antelope Valley Limestone	wackestone	this study
262	-1.34	-7.73		Antelope Valley Limestone	wackestone	this study
266.5	-1.34	-14.85		Antelope Valley Limestone	wackestone	this study
271	-0.77	-7.68		Antelope Valley Limestone	wackestone	this study
275.5	-0.26	-12.21		Antelope Valley Limestone	wackestone	this study
280	-0.69	-11.56		Antelope Valley Limestone	wackestone	this study
284.5	-0.52	-11.13		Antelope Valley Limestone	wackestone	this study
289	-0.45	-10.75		Antelope Valley Limestone	wackestone	this study
293.5	-1.20	-12.24		Antelope Valley Limestone	wackestone	this study
298	-1.83	-14.80		Antelope Valley Limestone	wackestone	this study
302.5	-0.55	-10.01		Antelope Valley Limestone	wackestone	this study
307	-1.06	-9.81		Antelope Valley Limestone	wackestone	this study
311.5	-1.28	-8.82		Antelope Valley Limestone	wackestone	this study
317.5	-2.50	-10.78		Antelope Valley Limestone	wackestone	this study
322	-2.01	-13.52		Antelope Valley Limestone	wackestone	this study
326.5	-0.81	-14.01		Antelope Valley Limestone	lime mudstone	this study

331	-0.83	-11.70		Antelope Valley Limestone	lime mudstone	this study
335.5	-0.95	-12.14		Antelope Valley Limestone	lime mudstone	this study
340	-0.39	-12.50		Antelope Valley Limestone	packstone	this study
346	-0.21	-9.81		Antelope Valley Limestone	wackestone	this study
350.5	-0.86	-9.35		Antelope Valley Limestone	wackestone	this study
358	-0.40	-9.69		Antelope Valley Limestone	packstone	this study
362.5	-0.67	-9.71		Antelope Valley Limestone	wackestone	this study
367	-0.95	-14.22		Antelope Valley Limestone	wackestone	this study
382	-1.35	-5.36		Copenhagen (Mbrs B + C)	wackestone	this study
386.5	-1.20	-6.04		Copenhagen (Mbrs B + C)	wackestone	this study
401.5	-1.78	-5.56		Copenhagen (Mbrs B + C)	wackestone	this study
404.5	-2.03	-5.48		Copenhagen (Mbrs B + C)	lime mudstone	this study
406	-1.13	-7.06		Copenhagen (Mbrs B + C)	wackestone	this study
413.5	-1.75	-6.31		Copenhagen (Mbrs B + C)	wackestone	this study
415	-1.81	-8.03		Copenhagen (Mbrs B + C)	lime mudstone	this study
418	-1.79	-8.37		Copenhagen (Mbrs B + C)	lime mudstone	this study
419.5	-1.47	-5.70		Copenhagen (Mbrs B + C)	wackestone	this study
424	-1.44	-5.95		Copenhagen (Mbrs B + C)	wackestone	this study
425.5	-1.32	-5.08		Copenhagen (Mbrs B + C)	wackestone	this study
427	-1.61	-5.10		Copenhagen (Mbrs B + C)	packstone	this study
428.5	-1.23	-5.19		Copenhagen (Mbrs B + C)	packstone	this study
430	-1.91	-5.73		Copenhagen (Mbrs B + C)	packstone	this study
431.5	-1.19	-5.32		Copenhagen (Mbrs B + C)	packstone	this study
433	-1.44	-6.09		Copenhagen (Mbrs B + C)	packstone	this study
436	-0.99	-4.91		Copenhagen (Mbrs B + C)	packstone	this study
439	-2.37	-4.23		Copenhagen (Mbrs B + C)	packstone	this study
442	-0.44	-5.18		Copenhagen (Mbrs B + C)	wackestone	this study
445	0.09	-5.49		Copenhagen (Mbrs B + C)	wackestone	this study
448	0.48	-5.03		Copenhagen (Mbrs B + C)	wackestone	this study
451	1.14	-4.63		Copenhagen (Mbrs B + C)	wackestone	this study
455.5	0.09	-4.94		Copenhagen (Mbrs B + C)	wackestone	this study
458.5	0.86	-4.65		Copenhagen (Mbrs B + C)	wackestone	this study
461	0.74	-5.59	-27.05	Copenhagen (Mbrs B + C)	wackestone	this study
463	0.85	-4.59	-27.48	Copenhagen (Mbrs B + C)	wackestone	this study
466.5	-0.48	-5.52		Copenhagen (Mbrs B + C)	packstone	this study
469.5	-1.14	-4.92		Copenhagen (Mbrs B + C)	packstone	this study
472	-0.42	-4.62	-26.71	Copenhagen (Mbrs B + C)	packstone	this study
474.5	0.14	-4.73		Copenhagen (Mbrs B + C)	packstone	this study
475	1.74	-4.54	-27.60	Copenhagen (Mbrs B + C)	wackestone	this study
475.5	2.00	-4.80		Copenhagen (Mbrs B + C)	wackestone	this study
477	1.16	-5.27	-27.57	Copenhagen (Mbrs B + C)	wackestone	this study
478	0.97	-6.19		Copenhagen (Mbrs B + C)	packstone	this study
479	1.25	-5.06	-27.57	Copenhagen (Mbrs B + C)	packstone	this study
480.5	1.14	-5.36		Copenhagen (Mbrs B + C)	packstone	this study
482	1.48	-4.89	-28.46	Copenhagen (Mbrs B + C)	packstone	this study
485	2.00	-4.50	-27.39	Copenhagen (Mbrs B + C)	packstone	this study
488	3.69	-5.12	-27.01	Copenhagen (Mbrs B + C)	packstone	this study
491	3.55	-4.88		Copenhagen (Mbrs B + C)	packstone	this study
492	3.34	-5.28	-27.41	Copenhagen (Mbrs B + C)	wackestone	this study
496.5	1.95	-5.01	-26.81	Copenhagen (Mbrs B + C)	wackestone	this study
498	1.83	-4.91		Copenhagen (Mbrs B + C)	packstone	this study
499.5	1.74	-5.34	-26.71	Copenhagen (Mbrs B + C)	wackestone	this study
501	2.17	-5.01	-27.31	Copenhagen (Mbrs B + C)	packstone	this study
504	2.08	-4.38		Copenhagen (Mbrs B + C)	packstone	this study
505.5	1.46	-5.15	-27.31	Copenhagen (Mbrs B + C)	packstone	this study
507	1.56	-4.87		Copenhagen (Mbrs B + C)	packstone	this study
510	1.02	-4.91	-27.06	Copenhagen (Mbrs B + C)	packstone	this study
513	1.37	-5.19		Copenhagen (Mbrs B + C)	packstone	this study
516	0.64	-5.15	-26.99	Copenhagen (Mbrs B + C)	packstone	this study
519	1.20	-4.50		Copenhagen (Mbrs B + C)	packstone	this study

576	-2.00	-13.41	Hanson Creek	lime mudstone	this study
588	-1.35	-6.66	Hanson Creek	lime mudstone	this study
603	-0.58	-5.47	Hanson Creek	wackestone	this study
607.5	-0.13	-9.51	Hanson Creek	lime mudstone	this study
624	0.43	-8.28	Hanson Creek	lime mudstone	this study
628.5	-0.20	-6.61	Hanson Creek	lime mudstone	this study
633	0.13	-7.78	Hanson Creek	lime mudstone	this study
642	0.68	-7.00	Hanson Creek	lime mudstone	this study
646.5	-0.02	-8.32	Hanson Creek	lime mudstone	this study
651	0.91	-5.85	Hanson Creek	lime mudstone	this study
655.5	0.66	-6.39	Hanson Creek	lime mudstone	this study
660	0.89	-6.29	Hanson Creek	lime mudstone	this study
664.5	0.87	-6.47	Hanson Creek	lime mudstone	this study
669	0.69	-6.62	Hanson Creek	lime mudstone	this study
673.5	0.82	-5.43	Hanson Creek	lime mudstone	this study
678	0.93	-5.63	Hanson Creek	wackestone	this study
682.5	0.49	-5.80	Hanson Creek	wackestone	this study
691.5	0.35	-4.23	Hanson Creek	wackestone	this study
700.5	0.89	-6.15	Hanson Creek	wackestone	this study
705	1.86	-4.57	Hanson Creek	wackestone	this study
714	2.16	-5.16	Hanson Creek	lime mudstone	this study
723	0.95	-8.49	Hanson Creek	lime mudstone	this study
727.5	2.67	-12.63	Hanson Creek	wackestone	this study
728	1.89	-6.19	Hanson Creek		Kump et al. 1999
732.1	0.88	-8.53	Hanson Creek		Kump et al. 1999
733.3	1.73	-11.54	Hanson Creek		Kump et al. 1999
737.2	1.43	-8.48	Hanson Creek		Kump et al. 1999
740.1	2.12	-11.41	Hanson Creek		Kump et al. 1999
742.7	2.47	-10.98	Hanson Creek		Kump et al. 1999
744.3	2.93	-14.58	Hanson Creek		Kump et al. 1999
746.7	1.67	-9.66	Hanson Creek		Kump et al. 1999
748.1	1.65	-5.61	Hanson Creek		Kump et al. 1999
750.8	2.08	-11.51	Hanson Creek		Kump et al. 1999
752.9	1.68	-12.89	Hanson Creek		Kump et al. 1999
754.9	1.19	-6.16	Hanson Creek		Kump et al. 1999
757.8	0.96	-7.6	Hanson Creek		Kump et al. 1999
760.6	1.25	-4.56	Hanson Creek		Kump et al. 1999
762.7	3.32	-5.83	Hanson Creek		Kump et al. 1999
764	4.41	-4.89	Hanson Creek		Kump et al. 1999
766	4.07	-8.15	Hanson Creek		Kump et al. 1999
767.4	5.45	-6.15	Hanson Creek		Kump et al. 1999
770.4	6.37	-4.26	Hanson Creek		Kump et al. 1999
772.2	6.41	-5.16	Hanson Creek		Kump et al. 1999
775	7.02	-6.41	Hanson Creek		Kump et al. 1999
776.9	6.14	-7.65	Hanson Creek		Kump et al. 1999
777.7	6.39	-6.39	Hanson Creek		Kump et al. 1999
779.7	6.68	-9.08	Hanson Creek		Kump et al. 1999
781.3	6.49	-6.99	Hanson Creek		Kump et al. 1999
782.3	6.81	-6.48	Hanson Creek		Kump et al. 1999
783.5	7.1	-6	Hanson Creek		Kump et al. 1999
787.1	6.49	-6.92	Hanson Creek		Kump et al. 1999
789.7	6.74	-6.91	Hanson Creek		Kump et al. 1999
791.4	6.87	-6.04	Hanson Creek		Kump et al. 1999
794.6	6.53	-5.81	Hanson Creek		Kump et al. 1999
796.5	6.29	-5.63	Hanson Creek		Kump et al. 1999
798.6	5.71	-4.71	Hanson Creek		Kump et al. 1999
799.4	5.39	-5.27	Hanson Creek		Kump et al. 1999
800.5	5.24	-5.9	Hanson Creek		Kump et al. 1999
802.7	4.98	-6.11	Hanson Creek		Kump et al. 1999
804.9	4.72	-7.7	Hanson Creek		Kump et al. 1999
806.1	3.73	-6.21	Hanson Creek		Kump et al. 1999

809.4	3.45	-2.91	Hanson Creek	Kump et al. 1999
813.5	1.05	-5.67	Hanson Creek	Kump et al. 1999
817.6	0.65	-6.05	Hanson Creek	Kump et al. 1999
820	0.21	-5.76	Hanson Creek	Kump et al. 1999
824.9	0.49	-5.68	Hanson Creek	Kump et al. 1999
828.8	0.08	-6.29	Hanson Creek	Kump et al. 1999
835.2	-0.77	-6.31	Hanson Creek	Kump et al. 1999
839.9	-0.13	-7.38	Hanson Creek	Kump et al. 1999
844.9	-1.16	-7.31	Hanson Creek	Kump et al. 1999

Data Repository Figure 1
Saltzman



Data Repository Figure 2
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