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In Memory of Michael P. Mann, a Dedicated Hydrologist, 1971 - 2005

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Letters to the Editor

Dear Editor of the Journal of the Nevada Water Resources Association,

I thought I would write this note as a "constructive criticism" of the article by the students of the University of Nevada Reno Hydrological Science program (Shanafield and others, 2005, Analysis of Hungry Valley Groundwater Pumping and Management, Washoe County, Nevada). I realize that this article was a learning experience for the students and they have done an excellent job of presenting and analyzing the data for the study. My comments concern only two small parts of the study that do not really affect the results. However, I feel that the students and the journal would benefit from perhaps learning about these issues from a reader of the journal. The first thing that I think would have helped readers would be to have a separate methods section for the paper. The methods for how the pumping tests were designed or varied over the different classes are not discussed and although some methodology is included in the analysis, it would be better if it was separated from the interpretation of the data. A methods section is generally present in most scientific journal articles. The methods section prepares the reader for the results and discussion, without distracting the reader. The presentation of the hydrochemical and isotopic data comes with no methodology at all and it is difficult for the reader to understand how the data were collected and when. Were the wells pumping at the time, how long had they been pumping when samples were collected, were any duplicates or quality control samples taken at the time? Although these data are not particularly important to the conclusions of the paper, if they are to be included, they should come with some scientifically defensible information. This leads me to my second concern, which is the isotope information. In this section the article states that: "Results of stable isotope analysis of groundwater from several Hungry Valley wells in 2003 (table 3) indicate delta Oxygen-18 ($\delta^{18}O$) values are significantly depleted relative to recent precipitation and modern groundwater," but there is no explanation as to how the authors came to that conclusion. Precipitation data for the valley are not presented that could be compared with the ground water results. In fact an article by Smith and others (2002) suggested that water with $\delta^{2}H$ ratios (which are also presented in table 3 of the article) of -110 to -129 per mil could all be present day recharge. This is not consistent with the oxygen isotope statements in this article. However, Smith and others (2002) also state that they do not use oxygen isotope data in their analyses because water that has percolated deeply into the subsurface has been subjected to geothermal heat that may promote isotopic exchange between the oxygen in the water and the oxygen in the rocks, which would greatly complicate the analysis. This exchange doesn't occur for hydrogen because of the small amount of exchangeable hydrogen in the rocks. Therefore oxygen isotopes may not be a good indicator of the age of the water. However, when Smith and others (2002) is examined closely, there is still a possibility that the water in the Hungry Valley aquifer may at least have an older water component. There is one value presented that is lighter than -129 per mil and winter precipitation in the mountains around this area is about 10-20 per mil heavier than the ratios found in the ground water. So overall, the conclusion that the water in Hungry Valley is definitively Pleistocene in age is somewhat questionable, but a mixture of both recent and Pleistocene water could be a reasonable explanation for the borderline ratios.

In summary, the purpose of this note is to show the authors that having unsupported information in an article can leave an author open to some criticism. It might have been best to leave the isotope information out of the article or to add more information that could solidly show that the isotope data indicates a Pleistocene age of the ground water. Once again, I believe the article is well written and a useful contribution to Nevada hydrology, as well as a significant learning experience for the students. I hope this minor criticism is seen only as a way for the students to further improve their skills as science writers.

Yours sincerely,

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Reference:

Smith, G.I., Friedman, I., Veronda, G., and Johnson, C.A., 2002, Stable isotope compositions of water in the Great Basin, United States 3.Comparison of groundwaters with modern precipitation. Journal of Geophysical Research , v. 107, no. D19, 4402, doi: 10.1029/2001JD000567.

Reply to Rosen (this Issue)
February 25, 2006

We appreciate the opportunity to reply to Rosen (this issue) and his "constructive criticism" on Shanafield and others (2005). Rosen (this issue) raises concerns over both editorial and technical conclusions, and we address these separately in the following paragraphs.

With respect to his editorial comment regarding our absence of separate section describing the methodologies used for in both the field testing and analysis of aquifer test data, we fully acknowledge that the methodologies for water quality sampling and analysis were not described in complete detail. However, we respectfully disagree with Rosen (this issue) that the manuscript necessarily "would be better" if a separate section describing the methodology had been provided. Modern scientific and engineering journals do permit a wide range of editorial style and as the primary focus of the manuscript was on drawdown management and the aquifer testing methods used in the manuscript (Theis method, etc.) were fairly routine, we therefore chose only to summarize these testing methods within the analysis section of the manuscript.

Shanafield and others (2005) briefly describes selected groundwater chemistry results taken over several years in Hungry Valley as part of class projects. The primary rationale for including groundwater chemistry results in Shanafield and others (2005) was to provide the reader with some background on the general water quality of the valley, as few analyses have been reported in publicly available sources for Hungry Valley. They were also included to insure that these analyses were not lost from the record as they had previously only been recorded in the form of student reports and homework. Rosen (this issue) is correct to point out that our limited discussion of these data can open the door for criticism.

Table 2 of Shanafield and others (2005) reported pH, temperature and electrical conductivity from wells TH-1, #4 and #7 during a class exercise including a pumping test in 2004 and we now provide in this reply additional details of the sampling. Samples from TH-1 and Well #7 were taken by bailer and analyzed in the field with an Oakton pH/conductivity field meter (Model #300). The wells could not be purged of any significant volume prior to sampling, and therefore may not be completely representative of aquifer water quality. The sample reported from Well #4 after the well had been pumped for 24 hours at ~130 gallons per minute. It therefore is a good representative sample of the producing zone(s) of Well #4. The large contrast in electrical conductivity between TH-1 and Well #4 is consistent with the electrical logs of TH-1 taken just after its drilling and was used by Shanafield and others (2005) to conclude that the uppermost screened interval of Wells #4 and #5 is the primary source of water in these wells.

Shanafield and others (2005) also report deuterium and oxygen-18 concentrations from selected springs and wells in Hungry Valley collected in March 1, 2003. Table 1 of this reply now summarizes the sampling methods and sample point conditions to provide the readers with a more complete picture of these data. These isotope samples were collected during a class exercise measuring water levels in Hungry Valley and had not been published previously.

TABLE 1. Details of stable isotope sampling locations reported by Shanafield et al. (2005).

NAME	TYPE	METHOD OF SAMPLING	SAMPLE LOCATION	DATE DRILLED	DATE LAST PUMPED*
TH-1	WELL	BAILER	WELLHEAD	1985	1985
TH-2	WELL	BAILER	WELLHEAD	1987	1987
Well#7	WELL	BAILER	WELLHEAD	Sept. 2001	Sept. 2001
WW-4	WELL	BAILER	WELLHEAD	Oct. 2001	Oct. 2001
Little Hungry Spring	SPRING	DIRECT	DRIPPING FRACTURE		
Hungry Spring	SPRING	DIRECT	DISCHARGE PIPE AT TROUGH		

*based upon RSIC Utility District Records

Shanafield and others (2005) state that the magnitude of isotopic depletion of both deuterium and oxygen-18 is “consistent with groundwater that was recharged under much cooler climatic conditions” and was also consistent with the “last significant recharge occurring ~13,000 years ago.” Based upon the results of Smith and others (2002), Rosen (this issue) points out that most of the samples with a deuterium concentration (δD VSMOW) between -110‰ and -129‰ could all be modern recharge. However, Smith and others (2002) also state that waters with δD concentrations ≥ 20‰ lighter (more negative) than mountain precipitation were “probably” accumulated during the Pleistocene and have not mixed significantly with Holocene waters. Waters with δD values between 10‰ and 19‰ lighter than modern mountain precipitation are considered by Smith and others (2002) to be “possibly representative of precipitation from an earlier climatic regime.” Smith and others (2002) go on to suggest that this earlier climatic regime was likely to be the Pleistocene.

Smith and others (2002) places the δD winter precipitation contour of -110‰ almost directly over Hungry Valley and, as a result, 5 of the 6 samples believed to be representative of the deep groundwater in Hungry Valley would fall into the "possible" Pleistocene category, with groundwater from well WW-4 25‰ lighter than the Smith and others (2002) winter precipitation contour and clearly falling into the "probable" Pleistocene category. We note that all of the groundwaters are actually close to this 20‰ criteria.

To further explore the timing of recharge in Hungry Valley, we now show in figure 1 of this reply the δD- $\delta^{18}O$ data from Shanafield and others (2005) along with isotopic analysis of all groundwaters reported by Friedman (2000) from the region ±0.25^{o} N-S latitude and E-W longitude centered on Hungry Valley. Also shown on figure 1 is Craig's (1961) global meteoric water line. Importantly, the Friedman (2000) database was used by Smith and others (2002) as their principal groundwater data. Figure 1 clearly demonstrates that the groundwaters of Hungry Valley (including Little Hungry Spring believed to be discharging regional groundwater) are, as a group, significantly lighter than all but one groundwater in the region. Most groundwater samples from this area are found between -110‰ δD and -120‰ δD. Interestingly, the one analysis from Friedman (2000) that groups with the Hungry Valley samples comes from a deep (205 m) well less than ~10 km south of Hungry Valley.

The majority of the remaining groundwaters in the vicinity of Hungry Valley are significantly heavier and cluster around the isotopic composition of Hungry Spring (-115‰ δD). Hungry Spring is located at the base of Hungry Ridge east of Hungry Valley and discharges from volcanic rocks. This low-volume spring has a small upland catchment area and is most likely recharged from modern precipitation. The majority of groundwaters shown in blue in figure 1 would be considered to be primarily recharged under modern conditions as defined by Smith and others (2002).

While the differences in isotopic composition of Hungry Valley groundwaters from those in the general area are not conclusive proof of Pleistocene recharge, we believe by placing the isotopic data in context of other samples in region clearly shows Hungry Valley groundwater isotopic compositions to be indicative of recharge under a past climate. The significant depth of screened intervals of the wells of Hungry Valley and limited modern recharge, combined with the confined conditions and thick sections of low permeability silt and clay overlying the producing zones are all conducive for developing and maintaining old groundwaters. We concur with Rosen (this issue) that some mixing of modern waters is certainly a possibility for Hungry Valley groundwater, however by considering the more extensive data base developed by Friedman (2000) and the hydrogeologic conditions, we remain convinced that the isotopic data are significantly depleted as compared to modern precipitation groundwaters of the area and that the principle source of the recharge to the deep aquifers of Hungry Valley occurred during Pleistocene climates.

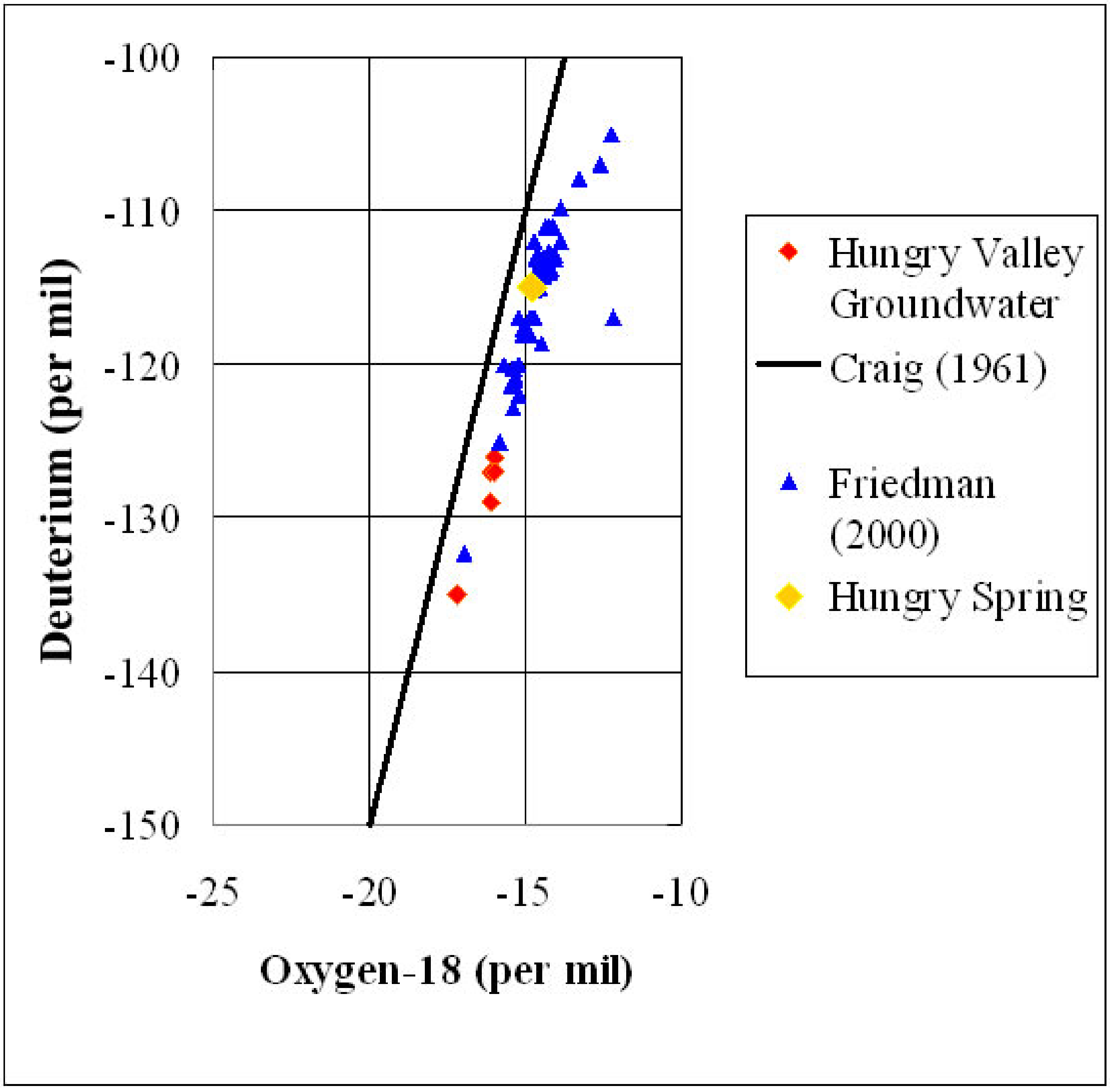

Figure 1. Deuterium (δD‰ VSMOW) and oxygen-18 (δ^{18}O‰ VSMOW) concentrations from Hungry Valley groundwater and springs along with groundwater analysis from all wells and springs reported by Friedman (2000) within ±0.25° of latitude and longitude of Hungry Valley. With the exception of Hungry Spring, believed to be representative of modern recharge, there is only one reported groundwater analysis lighter than those found in Hungry Valley.

Lastly, Rosen (this issue) raises concerns that the use of oxygen-18 data in Hungry Valley for paleorecharge may be compromised by rock/water exchanges. While we certainly acknowledge that oxygen data may be influenced by rock/water exchange, we do not believe that significant exchange is occurring in the groundwaters reported by Shanafield and others (2005). As can be seen in figure 1, the majority of groundwater samples from the region reported by Friedman (2000) as well as the Hungry Valley analysis show a fairly consistent 1‰ δ^{18}O shift or enrichment. This shift may be indicative of a systematic departure of precipitation in the region from global meteoric water line or may be the result of slight evaporative enrichment common in arid region recharge. However, it is unlikely that all of these groundwaters would have undergone this identical shift due to rock-water interactions, as suggested by Rosen (this issue) given the wide variety of aquifer conditions found in the area. Although we cannot conclusively rule out rock water interactions affecting the reported $\delta^{18}O$ data, it does not appear that any significant rock/water interactions have occurred to alter the $\delta^{18}O$ signature of most groundwaters in the area of Hungry Valley. We do however encourage additional research into the development of local meteoric water lines for future studies in this region.

We appreciate the opportunity to provide additional data on Hungry Valley and we thank Rosen (this issue) for his interest in our work.

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