Utah Geological Survey Geologic Field Investigation Following the February 21, 2008 Wells, Nevada, Magnitude 6.0 Earthquake

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INTRODUCTION

On February 21-22, 2008, the Utah Geological Survey (UGS) assisted the Nevada Bureau of Mines and Geology with the scientific response to the magnitude 6.0 Wells, Nevada, earthquake. The purpose of the UGS field investigation was to 1) look for surface faulting or ground cracking associated with mapped Quaternary faults, 2) document geologic evidence of strong ground shaking (e.g., liquefaction, ground cracks, rock fall, landslides, and shattered ground), and 3) provide geologic information to emergency response teams as necessary. This preliminary report is based on our field investigations; maps showing our field stops and photographs of certain stops are attached. Quaternary faults on the maps are taken from the U.S. Geological Survey (USGS) Quaternary fault and fold database of the United States.

SUMMARY OF FIELD INVESTIGATIONS

Our field investigations did not reveal any evidence for surface faulting or ground cracking, or geologic effects associated with strong ground shaking. However, our field observations were limited by very poor road conditions, up to several feet of snow cover, and over an inch of new snow accumulation overnight on February 21, which may have masked minor earthquake-related features.

We were able to observe (in the field) fault scarps associated with the southern section of the Independence Valley fault zone and Northern Snake Mountains fault. Additionally, we were able to cross the projected traces of unnamed faults west of Wells Peak (faults east of Wells) and the unnamed fault zone in northwest Clover Valley (faults south of Wells), but not directly observe mapped scarps associated with the faults in the field. We were unable to observe faults northeast of Wells, associated with the northern part of the unnamed faults west of Wells Peak.

In Wells, we searched for evidence of strong ground shaking such as liquefaction near a ruptured water main, the volunteer fire station, airport, and Humboldt River, but did not observe any geologic features that could be confidently associated with the earthquake. North of Wells on Highway 93 we responded to reports of rock falls, but were unable to find any rock falls or landslides associated with the earthquake.

FIELD INVESTIGATIONS

Stop 1 – Independence Valley

Our initial investigation on Thursday afternoon (February 21) focused on Quaternary fault scarps mapped along the eastern margin of Independence Valley. Early earthquake reports plotted the earthquake epicenter in the northwestern part of this valley. From the Independence Valley exit on I-80, we traveled east about 3 km on frontage road (FR) 435, and then southeast for about 6 km on dirt roads. We traveled within about 1.5 km of the northern segment of the Independence Valley fault zone, but were unable to reach the mapped fault scarps. We scanned the hillslopes with binoculars, but did not observe any evidence for surface faulting or geologic evidence of rock falls or landslides.

Stop 2 – Independence Valley

In Independence Valley, we continued south for about 6.5 km on dirt roads to Quaternary scarps associated with the southern section of the Independence Valley fault zone. This trace is mapped about 3 km west of the northern section. At this site, we parked at an active drilling pad and walked west along a dirt road that crosses the mapped fault trace. We observed (snow-covered) scarps north and south of the road (photo 1), but did not find any evidence for surface faulting, ground movement, or road damage. We also used binoculars to scan hillslopes along the western margin of the valley, but did not observe any evidence for rock falls or landslides.

Stop 3 – Independence Valley

From the I-80 Independence Valley exit, we traveled approximately 6 km northwest on FR 435. Our intent was to investigate the northwestern margin of the valley, in the area of the early epicenter location, although no Quaternary faults are mapped in this area. We did not observe surface faulting or geologic evidence for ground shaking, although considerable snow cover restricted our travel to FR 435.

In the late afternoon of February 21, we focused our efforts in the Wells valley (Town Creek Flat). From I-80, we traveled approximately 15 km north on Highway 93, with the intent of locating scarps mapped in the northeastern part of the valley. We were unable to reach the scarps due to snow-covered and impassable roads, and along Highway 93 did not observe any surface faulting or geologic evidence for strong shaking.

Stop 4 – Wells, Nevada

Friday morning (February 22) we observed a water main damaged during the Wells earthquake (photos 2 and 3). The main is located in the southwest part of town (Easy Street). The exposed, approximately 8-inch-diameter pipe showed no horizontal or vertical offset. Sediments exposed in the trench wall showed no signs of liquefaction or displacement; however, we did not enter the excavation and the walls had not been cleaned. Although recent snowfall hampered our efforts, we walked the surrounding area to look for ground cracks and liquefaction features, and found neither.

We also investigated the volunteer fire station on Clover Avenue, after receiving a report of a possible hummock near the building. We walked around the building, talked to firefighters onsite, and observed the train tracks northeast of the building, but observed no evidence for surface deformation.

Stop 5 – Wells Airport

We investigated a report of a possible "ground swale" near the fuel island at the Wells Airport, located about 3 km east-northeast of Wells. We walked around the fuel island, hanger and out buildings, and part of the runway, but observed no evidence for surface deformation clearly associated with the Wells earthquake. We did observe cracks in asphalt pavement, up to 1 inch wide, but could not preclude an origin other than the Wells earthquake (e.g., thermal expansion). A fault mapped as part of a group of "unnamed faults west of Wells Peak" is located east of the airport; however, we were unable to access this scarp.

Stop 6 – Unnamed Faults West of Wells Peak

From the junction of I-80 and Highway 93 we traveled about 3.5 km east on I-80 to a parking area. We walked west along I-80, and looked for scarps related to faults labeled "unnamed faults west of Wells Peak" in the USGS Quaternary fault and fold database. We walked about 0.5 km west, but were unable to find the scarps. We did not travel off the road due to snow cover. We did not observe any damage to I-80, which crosses the scarp.

Stop 7 – Unnamed Fault Zone in Northwest Clover Valley

We drove about 14 km south of Wells on Highway 93 with the intent of observing scarps associated with mapped faults south of Wells. The faults, mapped as an "unnamed fault zone in northwest Clover Valley," bound a minor range east of the East Humboldt Range and extend discontinuously through the middle of the valley. We were unable to access scarps in the western part of the valley due to impassable roads. Scarps crossed by the highway were not obvious from the road. We did not observe any surface faulting, geologic evidence for shaking, or road damage, and a Union Pacific rail line traversing the valley was operational and showed no apparent damage.

Stop 8 –Faults Southwest of Wells

From the intersection of Humboldt Avenue and Angel Lake Road, we traveled about 2.3 km west on Angel Lake Road, looking for fault scarps about 3 km southwest of town and possibly associated with the unnamed fault zone in northwest Clover Valley. Based on late Holocene timing of most recent surface faulting, the northernmost part of this fault may have ruptured sympathetically with the Ruby Mountains fault zone. We did not find the mapped trace of the fault and did not find any evidence for surface faulting or strong ground shaking. We did observe a minor swale in the road in line with

the fault trace, but could not preclude an origin other than the Wells earthquake (e.g., settlement of road subgrade).

Stop 9 – Contact, Nevada

In response to news reports of rock falls (and road closure) on Highway 93 north of Wells, we traveled north on the highway for approximately 75 km. We observed steep road cuts and exposed bedrock near Contact, Nevada, but did not observe any road-cut failures, rock falls, or other evidence for strong ground shaking.

Stop 10 – Humboldt River

From the intersection of Wells Avenue and 9th Street, we traveled about 1.5 km north to the Humboldt River (Stop 10a). We investigated the wide flood plain southeast of the main channel of the river (now mostly dry, photo 4) and searched, but did not find evidence for liquefaction (e.g., sand blows or ground cracks). We also looked for liquefaction features about 1.3 km northwest of the intersection of Wells Avenue and 8th Street (Stop 10b). In this area, surface water is flowing west, and the banks and marsh areas are mostly covered by ice. We did not observe any evidence for liquefaction or lateral spreading along stream banks. We did not investigate the Humboldt River or Town Creek northeast of Wells due to impassable roads.

Stop 11 – Northern Snake Mountains Fault

From the last stop, we continued west to the intersection of 8th Street and Highway 754 (Stop 11a), looking for surface faulting or ground cracks associated with the Northern Snake Mountains fault (photos 5 and 6). We traveled about 1.5 km north on Highway 754 and walked a dirt road that crosses the main trace of the fault (Stop 11b). Deep snow drifts impeded travel, and we did not observe any ground deformation or road damage.

Photo 1. Fault scarps along the Independence Valley fault zone, southern section.

Photo 2. Water main break in Wells.

Photo 3. Water main break in Wells.

Photo 4. Humboldt River flood plain.

Photo 5. Fault scarps along the Northern Snake Mountains fault (Ruby Range in background).

Photo 6. Fault scarps along the Northern Snake Mountains fault.