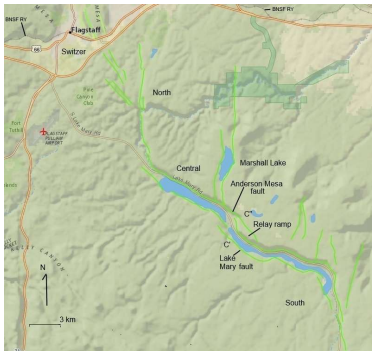
The Lake Mary Fault and Flagstaff, Arizona

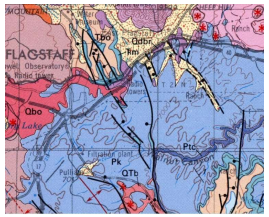
David S. Brumbaugh, Northern Arizona University, Arizona Earthquake Information Center, Flagstaff, Arizona 86001, e-mail: david.brumbaugh@nau.edu, Tel9286074631

Abstract

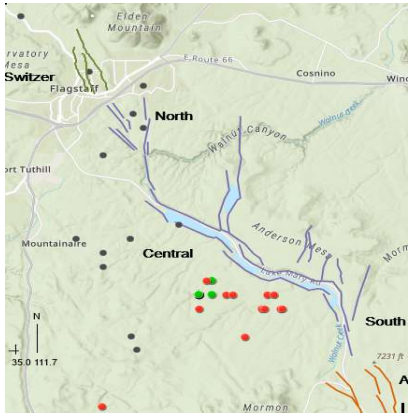
The Lake Mary fault system is a seismically active group of interconnected faults which at the northern end crosses through the heart of the city of Flagstaff, Arizona, an urban area of more than 70,000 people. The earthquake activity from the fault system has included earthquake swarms and tremors as large as magnitude MS 6.2 (1912). Fault plane solution analysis indicates that Mw> 3.0 events are a response to NE-SW extension in a pre-fractured crust. The earthquake history, fault data, and estimates of potential ground shaking indicate that the Lake Mary fault system has the potential to produce earthquakes as large as Mw 7.0 which could result in significant damage to Flagstaff.



Lake Mary fault system segments: labeled green lines = fault trace. (after US Quaternary faults map)



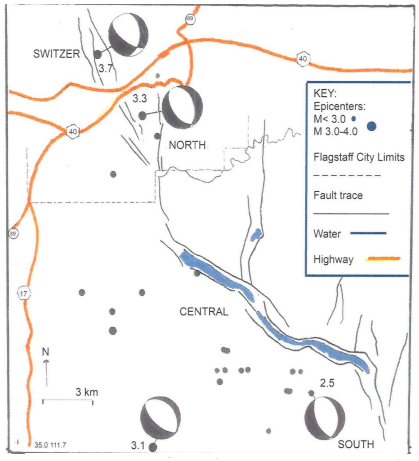
Flagstaff Area, thick: black lines =fault traces. From U.S.G.S. Arizona Geologic map



Epicenter distribution: red dots= 2011 swarm, green dots= 1979 swarm

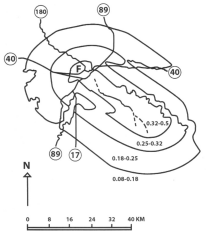
Date	Time	Lat x Long	Depth	Mag
08-18-1912	14:30	35.25 x111.720	25.0	6.2
04-20-1972	13.28	35.21 x 111.640	5.0	3.7
10-05-1979	00:13	35.05 x111.560	17.4	-
10-05-1979	01:11	35.05 x111.555	17.9	-
10-05-1979	16:57	35.05 x111.560	17.0	2.6
10-05-1979	17:07	35.05 x111.560	17.2	-
10-05-1979	21.57	35.06 x111.555	17.4	-
10-05-1979	23:43	35.05 x111.560	17.8	-
10-06-1979	00:46	35.05 x111.560	17.9	1.4
10-06-1979	07:09	35.05 x111.560	17.8	2.1
10-06-1979	07:14	35.05 x111.560	18.0	2.1
10-06-1979	07:41	35.05 x111.560	17.5	1.3
10-06-1979	07:51	35.05 x111.560	18.2	1.4
10-06-1979	09:28	35.05 x111.560	17.8	2.5
10-06-1979	10:57	35.05 x111.560	17.9	-
10-07-1979	04:46	35.05 x111.560	18.2	-
12-06-1981	09:09	35.17 x111.600	-	2.0
04-02-1987	12:49	35.25x 111.690	11.0	2.6
04-18-1990	00:29	35.08 x111.630	18.0	2.2
10-20-1992	14:32	35.15 x111.630	8.0	1.9
02-06-1995	14:28	35.07 x111.630	(10.0)	3.0
07-25-1995	22:50	35.09 x111.650	(10.0)	1.7
07-03-1996	05:16	35.09 x111.610	(10.0)	2.0
05-30 1998	03:54	35.09x111.610	(10.0)	2.2
12-06-1999	14:20	35.01 x111.605	5.6	3.1
12-26-2001	05:37	35.10 x111.574	(10.0)	1.2
07-27-2003	06:29	35.20 x111.600	-	1.3
03-18-2010	06:50	35.02 x111.609	-	2.7
06-21-2011	10:36	35.04 x111.500	9.0	2.5
06-21-2011	07:41	35.06 x111.554	16.2	2.7
06-24-2011	22:01	35.04 x111.514	3.5	2.5
06-24-2011	22:03	35.02 x111.526	17.3	2.7
06-24-2011	22:06	35.05 x111.510	3.0	2.4
06-24-2011	22:28	34.97 x111.631	6.4	2.3
06-24-2011	23:54	35.05 x111.505	4.7	2.3
06-25-2011	07:13	35.04 x111.512	2.3	2.3
06-25-2011	09:27	35.04 x111.499	6.8	2.0
06-25-2011	11:02	35.04 x111.560	3.5	2.5
06-26-2011	08:25	35.04 x111.540	7.0	2.0
06-26-2011	10:41	35.05 x111.535	1.8	2.5
11-26-2011	21:31	35.17 x111.541	5.0	3.1
04-07-2021	09:20	35.18 x111.608	5.0	3.3

Earthquakes in Lake Mary area

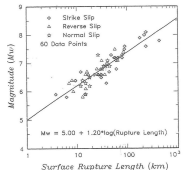


Fault Plane Solution Data for M>3.0

Date	Nodal Plane 1			Nodal Plane 2			P Axis		T Axis		
	Strike	Dip	Rake	Strike	Dip	Rake	Az	Pl	Az	Pl	Var
4-20-1972	125	62	-124	0.0	43	-43	347	58	240	10	0.152
12-6-1999	148	61	-94	337	30	-82	47	74	241	16	0.000
4-7-2021	137	51	-104	341	42	-71	348	77	238	5	0.000
6-21-2011	160	57	-101	0.0	35	-73	37	75	258	11	0.00



Potential ground acceleration from M=6.4 from Lake Mary fault



Fault surface trace Length vs Magnitude

Discussion Analysis of the epicenter distributions and results of the orientation of fault plane solutions and comparison to trend of the surface fault traces of the Lake Mary fault segments suggests that sections of the fault are still slipping and releasing stress. Given the fault location close to and within Flagstaff as well as overall length of the fault the potential for hazardous ground shaking exists.