Geosciences 145
Winter 2005
Syllabus

Week	Date		Topic
1	1/09/06-1/13/06		Seismic velocity, seismic methods-refraction Reading: Sections 4.2, 7.1, 7.2, 3.3.1; Notes-Rocks 1-6,Seismic 1-15
	1/10/06	1400-1530	Lecture Geol 1207
	1/10/06	1800-2100	Lab 1-Computer Orientation Watkins 2101
	1/12/06	1400-1530	Lecture Geol 1207
2	1/16/06-1/20/06		Seismic methods - refraction Reading: Chapter 5; Notes-Seismic 1-15
	1/17/06	1400-1530	Lecture Geol 1207
	1/17/06	1800-2100	Office hours Watkins 2101 NO LAB – Field trip on 2/4/06
	1/19/06	1400-1530	Lecture Geol 1207
3	1/23/06-1/27/06		Seismic methods - reflection Reading: MacRay manual (in Science Library); Text-Chapter 6; Notes-Seismic 17-24
	1/24/06	1400-1530	Lecture Geol 1207
	1/24/06	1800-2100	Lab 3 – MacRay interpretation (computer) Watkins 2101
	1/26/06	1400-1530	Lecture Geol 1207
4	1/30/06-2/03/06		Electrical resistivity, Electrical methods Reading: Chapter 7; Notes-Rocks 6-10, DC 1-16
	1/31/06	1400-1530	Lecture Geol 1207
	1/31/06	1800-2100	Office hours Watkins 2101 NO LAB – Field trip on 2/4/06
	2/02/06	1400-1530	Lecture Geol 1207
	2/03/06-2/04/06		**FIELD TRIP 1 – Seismic Refraction, dc resistivity**
5	2/06/06-2/10/06		Electrical resistivity - dc resistivity Reading: Notes- DC 17-29
	2/4/06	1400-1530	Lecture Geol 1207
	2/4/06	1800-2100	Lab 6 - EINVRT Geol 1207
	2/6/06	1400-1530	Lecture Geol 1207
6	2/13/06-2/17/06		Magnetic properties, Magnetic methods

		Reading: Chapter 3; Notes: Rocks 12, Magnetics 1-12	
		MIDTERM: Take-home exam distributed	
2/14/06		**FIELD TRIP REPORT #1 DUE**	
2/14/06	1400-1530	Lecture	Geol 1207
2/14/06	1800-2100	Office hours	Watkins 2101
		NO LAB – FIELD TRIP 3/4/06	
2/16/06	1400-1530	Lecture	Geol 1207
2/16/06		**MIDTERM DISTRIBUTED**	
7	2/20/06-2/24/06	Electromagnetic methods-basics,FDEM	
		Reading: Chapter 10, Section 11.1,11.2; Notes-EM 1-10	
2/21/06	1400-1530	Lecture	Geol 1207
2/21/06	1800-2100	Office hours	Watkins 2101
		NO LAB – FIELD TRIP 3/4/06	
2/23/06	1400-1530	Lecture	Geol 1207
2/23/06		**MIDTERM DUE 1400**	
2/23/06		**REVISED FIELD TRIP REPORT #1 DUE**	
8	2/27/06-3/03/06	Electromagnetic methods-GPR	
		Reading: Chapter 12; Notes-EM 11-14	
		Lab: Lab 8, GPR	
		Lab report due: 1 week later	
2/28/06	1400-1530	Lecture	Geol 1207
2/28/06	1800-2100	Office hours	Watkins 2101
		NO LAB – FIELD TRIP 3/4/06	
3/02/06	1400-1530	Lecture	Geol 1207
3/04/06		**FIELD TRIP #2 – Magnetics, EM profiling, GPR**	
9	3/6/06-3/10/06	Electromagnetic methods-TDEM	
		Reading – Section 11.3	
		Lab: Lab *, EINVRT - TDEM interpretation	
3/7/06	1400-1530	Lecture	Geol 1207
3/7/06	1800-2100	Lab – TDEM interpretation with EINVRT	Geol 1207
3/9/06	1400-1530	Lecture	Geol 1207
10	3/13/06-3/17/06	GIS applications -spatial analysis of data	
		Reading: Notes-GIS 1-13	
		Lab: Lab 9, GIS Computer exercises	
3/14/06	1400-1530	Lecture	Geol 1207
3/14/06		**FIELD TRIP #2 REPORT DUE**	
3/14/06		**FINAL DISTRIBUTED**	
3/14/06	1800-2100	Lab- GIS	Geol 1207
3/16/06	1400-1530	Lecture	Geol 1207

FINAL DUE: Monday, March 20, 2006 by 14:30

Grading basis: Class participation (20%), Lab reports (20%), Homework (20%), Midterm (10%), Final (30%).

Required Materials:

1.Text: "An Introduction to Applied and Environmental Geophysics", by J.M. Reynolds

2. Computer disk of programs to be supplied by instructor.

3. Computer disks for both Mac and PC (not same!) - 1 of each at least.

3. Bound field notebook (a composition book from the bookstore will do).

4. Calculator

5. Lab manual from printing and reprographics next to bookstore

6. Copies of overheads from printing and reprographics.

Optional Materials:

1. Lecture notes from printing and reprographics (includes old tests, etc).

Other reading assignments will be made from:

1. Geotechnical and Environmental Geophysics, Volumes 1-3, Stanley Ward (ed.), Society of Exploration Geophysicists, 1990.

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Week 1 - Rock Properties

Reading:

Reynolds – Sections 4.2, 7.1, 7.2, 3.3.1

References:

Burger, p. 7-19, 241-246, 294-295, 389-397.

Ward, S.H., and D.C. Frasier, 1967, Conduction of electricity in rocks, in *Mining Geophysics*, vol. II, Society of Exploration Geophysicists, Tulsa, 197-223.

Dobrin, M.B., 1976, *Introduction to Geophysical Prospecting*, 3rd Edition, Mc-Graw Hill, New York, 630 pp.

Telford, W.M., L.P. Geldart, and R.E. Sheriff, 1990, *Applied Geophysics*, 2nd Edition, Cambridge University Press, New York, 770 pp.

Winsauer, W.O., and W.M. McCardell, 1953, Ionic double-layer conductivity in reservior rock, *Petroleum Trans. AIME, 198*, 129-223.

Vinegar, H.J., and M.H. Waxman, 1984, Induced polarization of shaly sands, *Geophysics, 49*, 1267-1287.

Park, S.K., and S.K. Dickey, 1989, Accurate estimation of conductivity of water from geoelectrical measurements - a new way to correct for clay, *Ground Water, 27*, 786-792.

Touloukian, Y.S., and C.Y. Ho, *Physical Properties of Rocks and Minerals*, vol. II-2, McGraw-Hill/CINDAS data series on material properties, McGraw-Hill, New York, 548 pp.

Mobilities of common ions:

Ion	Na^+	K^+	Ca^{2+}	Mg^{2+}	Cl^-	HCO_3^-	SO_4^{2-}	H^+	OH^-
Mobility (U_i) ($X10^5$ cm^2/sec-volt)*	50*	74	120	106	76	45	160	350	198

*Mobility of Na is $50X10^{-5}$ cm^2/sec-volt, for example.

Week 2 - Seismic Refraction Method

Reading: Reynolds – Chapter 5

References:

Burger p. 19-35
Burger, Chapter 3

Week 3 - Seismic Reflection Method

Reynolds - Chapter 6

References

Burger, Chapter 4

Steeples, D.W., and R.D. Miller, Seismic reflection methods applied to engineering, environmental, and groundwater problems, in *Geotechnical and Environmental Geophysics*, S.H. Ward (ed.), Volume 1, 1-30.

Park, S.K., D. Pendergraft, W.J. Stephenson, K.M. Shedlock, and T.C. Lee, 1995, Delineation of Intrabasin structure in a dilational jog of the San Jacinto fault zone, southern California, *J. Geophys. Res., 100*, 691-702.

Weeks 4,5 - Resistivity Methods

Reading – Reynolds, Chapter 7

References

Burger, Chapter 5

Telford, W.M., L.P. Geldart, and R.E. Sheriff, 1990, *Applied Geophysics*, 2nd Edition, Cambridge University Press, New York, 522-577.

Fox, R.C., G.W. Hohmann, T.J. Killpack, and L. Rijo, 1980, Topographic effets in resistivity and induced polarization surveys, *Geophysics, 45*, 75-93.

Owen, W.P., S.K. Park, and T.C. Lee, Delineation of a discontinuous aquitard with vertical electrical soundings, San Bernardino valley, southern California, *Ground Water, 29*, 418-424.

DeGery,

Park, S. K., and G. P. Van, 1991, Inversion of pole-pole date for three-dimensional resistivity structure beneath arrays of electrodes, *Geophysics, 56*, 956-970.

Van, G. P., S.K. Park, and P. Hamilton, 1991, Monitoring leaks from storage ponds using resistivity methods: Short Note in *Geophysics, 56* 1267-1270.

Park, S.K., 1997, Fluid migration in the vadose zone from 3-D inversion of resistivity monitoring data, *Geophysics, 63*, 41-51, 1998.

Week 6 - Magnetic Methods

Reading – Reynolds – Chapter 3

References

Burger, Chapter 7

Telford, W.M., L.P. Geldart, and R.E. Sheriff, 1990, *Applied Geophysics*, 2nd Edition, Cambridge University Press, New York, 62-136.

Gibson, T.H., 1986, Magnetic prospection on prehistoric sites in Western Canada, *Geophysics, 51*, 553-560.

Pattantyus-A., M., 1986, Geophysical results in archaeology in Hungary, *Geophysics, 51*, 561-567.

(Volume 51, No. 3 of *Geophysics* is special issue on geophysical methods in archaeology)

Weeks 7,8 - Electromagnetic Methods

Reading – Reynolds- Chapter 10, Sections 11.1, 11.2

References

Frischknecht, F.C., V.F. Labson, B.R. Spies, and W.L. Anderson, 1991, Profiling methods using small sources, in *Electromagnetic Methods in Applied Geophysics*, Nabighian, M.N. (ed.), Society of Exploration Geophysicists, Tulsa, 105-270.

Spies, B.R., and F.C. Frischknecht, 1991, Electromagnetic sounding, in *Electromagnetic Methods in Applied Geophysics*, Nabighian, M.N. (ed.), Society of Exploration Geophysicists, Tulsa, 285-426.

Oristaglio, M.L. and G.W. Hohmann, 1984, Diffusion of electromagnetic fields into a two-

dimensional earth: A finite difference approach, *Geophysics, 49*, 870.

Nabighian, M.N., 1979, Quasi-static transient response of a conducting half-space: An approximate representation, *Geophysics, 44*, 1700-1705.

Buselli, G., C. Barber, G.B. Davis, and R.B. Salama, Detection of groundwater contamination near waste disposal sites with transient electromagnetic and electrical methods, in *Geotechnical and Environmental Geophysics*, S.H. Ward (ed.), Volume 2, 27-40.

Ground Penetrating Radar

Reading – Reynolds – Chapter 12

References

Vaughan, C.J., 1986, Ground penetrating radar surveys used in archaeological investigations, *Geophysics, 51*, 595-604.

Bevan, B.W., 1991, The search for graves, *Geophysics, 56*, 1310-1319.

Fisher, E., G.A. McMechan, and A.P. Annan, 1992, Acquisition and processing of wide-aperture ground-penetrating radar data, *Geophysics, 57*, 495-504.

Goodman, D., 1994, Ground-penetrating radar simulation in engineering and archaeology, *Geophysics, 59*, 224-232.

Material	Dielectric Constant	Conductivity (mS/m)	Velocity (m/ns)	Attenuation (dB/m)
Air	1	0	0.3	0
Distilled Water	80	0.01	0.033	0.002
Fresh Water	80	0.5	0.033	0.1
Sea Water	80	30000	0.01	1000
Dry Sand	3-5	0.01	0.15	0.01
Saturated Sand	20-30	0.1-1.0	0.06	0.03-0.3
Limestone	4-8	0.5-2	0.12	0.4-1
Shale	5-15	1-100	0.09	1-100
Silts	5-30	1-100	0.07	1-100
Clays	5-40	2-1000	0.06	1-300
Granite	4-6	0.01-1	0.13	0.01-1
Dry Salt	5-6	0.01-1	0.13	0.01-1
Ice	3-4	0.01	0.16	0.01

(From Sensors and Software Pulse EKKO software)

Material	Dielectric Constant	Velocity (m/ns)
Dry sand/gravel	3-5	0.15
Wet sand/gravel	5-16	0.07-0.14
Dry Clay/Silt	3-5	0.15
Wet Clay/Silt	5-40	0.05-0.14
Fresh water	81	0.03
Granite	4-9	0.10-0.15
Air	1	0.30

(From Vaughan, 1986)

Week 9, 10 - GIS Applications

References

ESRI, 1994, *Understanding GIS: The ARC/INFO Method*, Environmental Systems Research Institute, Redlands.

Walker, J.D., R.A. Black, J.K. Linn, A.J. Thomas, R. Wiseman, and M.G. D'Atillio, 1996, Development of geographic information systems-oriented databases for integrated geological and geophysical applications, *GSA Today, 6*, 1-7.

Park, S.K., and J.R. Knott, 1994, Use of GIS for estimation of liquefaction susceptibility: An example from the San Bernardino basin, California, pp. 41.

Park, S.K., and E. Lehmer, 1994, Development of earthquake information data bases by the Southern California Earthquake Center (SCEC), *Proc. of the Geoscience Info. Soc., 25*, 21-32.

Park, S.K., and S. Elrick, 1998, Predictions of shear wave velocities in southern California using surface geology, *Bull. Seismo. Soc. Am., 88*, 677-685.

Contacts:

Web site for room reservations: www.cnc.ucr.edu/scs