Laboratory of Soil Mechanics – Chair « Gaz Naturel » Petrosvibri

Prof. Lyesse Laloui, Director

Phone/fax: +41(0)216932315/4153
Web: http:// lms.epfl.ch/en

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

YEARLY REPORT 2015

Soil Mechanics Laboratory - Chair "Gaz naturel" Petrosvibri

lms.epfl.ch

LMS | ACTIVITY REPORT 2015

Courses taught

BA, MA and Doctoral level at EPFL

Spring semester 2015

Teacher(s)	Code	Course title	Section-Semester	Credits	Student number
Golay, François (LASIG) ; **Tacher**, Laurent (LMS) ; **Simeonov**, Valentin (LTE) ; **Graf**, Franz (TSAM) ; **Murith**, Christophe (SAR-ENS) ; **Makhnenko**, Roman (LMS)	AR-344	Construire dans les zones à radiations naturelles	ENAC-BA6	4	21
Tacher, Laurent (LMS) ; **Vulliet**, Laurent (LMS)	CIVIL-203	Mécanique des sols et écoulements souterrains	GC-BA4	5	104
Laloui, Lyesse (LMS) ; **Ferrari**, Alessio (LMS)	CIVIL-530	Slope stability	GC-MA2, GC-MA4	3	27

Fall semester 2015

Teacher(s)	Code	Course title	Section-Semester	Credits	Student number
Ferrari, Alessio (LMS)	ME-705	Experimental Geomechanics	EDME	1	8
Vulliet, Laurent (LMS) ; **Defert**, Raphaël (SGC-ENS)	CIVIL-438	Analyse et gestion de risques	GC-MA1, GC-MA3	3	73
Tacher, Laurent (LMS)	CIVIL-403	Géologie de la construction et de l'environnement	GC-MA1, GC-MA3	3	63
Laloui, Lyesse (LMS) ; **Koliji**, Azad (SGC-ENS)	CIVIL-402	Geomechanics	GC-MA1, GC-MA3	3	125
Gnansounou, Edgard (GR-GN) ; **Laloui**, Lyesse (LMS) ; **Nussbaumer**, Alain (RESSLAB) ; **Wienold**, Jan (LIPID)	CIVIL-474	UE génie civil: Construction durable	GC-MA1, GC-MA3	4	59

Additional teaching

Empty category

Advising

Postdoc works (completed in 2015 or ongoing)

Advisee	Research topic	Starting (month/year)	End, if known (month/year)	Supervisor(s)	Advisee institution (if not EPFL)
Dieudonné, Anne-Catherine (LMS)	Numerical modelling of geological disposal for nuclear waste	12/2015		**Laloui**, Lyesse (LMS)	
Makhnenko, Roman (LMS)	Reservoir Modelling and Validation in Geo-Energies	07/2013		**Laloui**, Lyesse (LMS)	
Molnar, Iulia-Consuela	Energy piles for hot areas	11/2014	05/2015	**Laloui**, Lyesse (LMS)	
Vilarrasa Riano, Victor (LMS)	Coupled THM analysis of CO2 storage in deep saline formations	11/2014	04/2016	**Laloui**, Lyesse (LMS)	

PhD thesis (completed in 2015 or ongoing)

Advisee	Thesis title	Doctoral Program	Completion year	Advisor(s)	Co-advisor(s)	Other(s)	Advisee institution (if not EPFL)
Cassini, Etienne André (LMS)	Coupled Thermo-Hydro-Chemo-Mechanical modeling of bentonite in the context of nuclear waste storage	EDME	2017	**Laloui**, Lyesse (LMS)			
Crisci, Eleonora (LMS)	Advanced constitutive law for Opalinus Clay	EDME	2019	**Laloui**, Lyesse (LMS)	**Ferrari**, Alessio (LMS)		
Favero, Valentina (LMS)	Thermo-Hydro-Mechanical characterization of shales	EDME	2015	**Laloui**, Lyesse (LMS)	**Ferrari**, Alessio (LMS)		
Grangier, Samuel (LMS)	Effect of desiccation cracks on the stability of slopes	EDME	2019	**Laloui**, Lyesse (LMS)			
Li, Chao (LMS)	Multiphase Thermo-Hydro-Mechanical Processes induced by CO2 injection into deep saline	EDME	2016	**Laloui**, Lyesse (LMS)			

	aquifers						
Manca, Donatella (LMS)	Gas flow propagation and related Chemo-Hydro-Mechanical response of sand bentonite mixture	EDME	2015	**Laloui**, Lyesse (LMS)	**Ferrari**, Alessio (LMS)		
Minardi, Alberto (LMS)	Gas testings in shales	EDME	2017	**Laloui**, Lyesse (LMS)	**Ferrari**, Alessio (LMS)		
Mylnikov, Danila (LMS)	Experimental investigation of host and cap rock interaction with CO2	EDME	2018	**Laloui**, Lyesse (LMS)	**Makhnenko**, Roman (LMS)		
Parisio, Francesco (LMS)	Hydro-mechanical damage model for anisotropic shales (Opalinus Clay): Constitutive modelling and numerical	EDME	2016	**Laloui**, Lyesse (LMS)			
Qiao, Yafei (LMS)	Thermo-hydro-mechanical coupled analysis of the deep geological repository with a focus on mechanical constitutive models	EDME	2016	**Laloui**, Lyesse (LMS)	**Ding**, Wenqi		Department of Geotechnical engineering, Tongji University, China (World Universities)
Rotta Loria, Alessandro (LMS)	On the geo-structural behaviour of thermo-active pile groups under mechanical and thermal cyclic actions	EDME	2017	**Laloui**, Lyesse (LMS)			
Schicchi, Giovanni (LMS)	Themomechanical characterization of energy geostructures with emphasis on energy tunnels	EDME	2019	**Laloui**, Lyesse (LMS)			
Sutman, Melis (LMS)	Thermo-Mechanical Behavior of Energy Piles:Full-Scale Field Testing and	EDME	2016	**Laloui**, Lyesse (LMS)	**Olgun**, C. Guney		Department of Civil and Environmental Engineering, VirginiaTech,

	Numerical Modeling						USA (World Universities)
Terzis, Dimitrios (LMS)	Geomechanical constitutive model for bio--improved soils	EDME	2017	**Laloui**, Lyesse (LMS)			
Zou, Yang (LMS)	Wave propagation across rock fractures in two dimensions	EDME	2016	**Laloui**, Lyesse (LMS)	**Zhao**, Jian (SGC-ENS)		

Master diploma projects in Civil Engineering, Environmental Engineering and other programs (completed in spring 2015)

Advisee	Project title	Section-Semester	Advisor(s)	Co-advisor(s)	Advisee institution (if not EPFL)
Grangier, Samuel (LMS)	Glissement-coulée de Pont-Bourquin: analyse du comportement hydro-mécanique	GC-PME	**Laloui**, Lyesse (LMS)	**Ferrari**, Alessio (LMS)	
Wiseman, Camilla Elizabeth Clio Bérengère (GC-PME)	Experimental assessment of host rock response due to CO2 injection	GC-PME	**Laloui**, Lyesse (LMS)	**Makhnenko**, Roman (LMS)	

Master diploma projects in Architecture (completed in spring 2015, direct link to Infoscience)

Empty category

Prestudies of master projects in Civil Engineering (completed in fall 2015)

Advisee	Project title	Section-Semester	Tutors(s)	Supervisors(s)	Advisee institution (if not EPFL)
Gonzalez Dominguez, Etienne (GC-MA3)	Dimensionnement de pieux énergétiques	GC-MA3	**Laloui**, Lyesse (LMS)		
Grangier, Samuel (LMS)	Glissement-coulée de Pont-Bourquin: analyse du comportement hydro-mécanique	GC-PME	**Laloui**, Lyesse (LMS) ; **Ferrari**, Alessio (LMS)		
	Modelling transport				

Melot, Geoffroy (GC-H)	phenomenon in MX-80 bentonite with homogenisation tools and application to nuclear waste storage	GC-H	**Laloui**, Lyesse (LMS)		
Questi, Giorgia (GC-MA3)	Etude géotechnique d'un ouvrages d'amenées d'un aménagement hydro-électrique	GC-MA3	**Laloui**, Lyesse (LMS)		
Reverdin, Terence Len (GC-MA3)	Etude géotechnique d'un tunnel ferroviaire	GC-MA3	**Laloui**, Lyesse (LMS)		
Sautier, Cyrille Louis Etienne (GC-MA3)	Quantification de l'efficacité de la galerie de drainage de 2008 sur le glissement de terrain de La Frasse	GC-MA3	**Laloui**, Lyesse (LMS)		
Schischlik, Clara (GC-MA3)	Etude et dimensionnement d'un tunnel ferroviaire (provisoire)	GC-MA3	**Laloui**, Lyesse (LMS)		
Taha, Hani (GC-MA3)	Bio-cementation (provisoire)	GC-MA3	**Laloui**, Lyesse (LMS)		
Wiseman, Camilla Elizabeth Clio Bérengère (GC-PME)	Experimental assessment of host rock response due to CO2 injection	GC-PME	**Laloui**, Lyesse (LMS) ; **Makhnenko**, Roman (LMS)		

Theoretical statements of master projects in Architecture (completed in january 2015, direct link to Infoscience)

Empty category

Semester projects (completed in 2015)

Advisee	Project title	Section-Semester	Tutor(s)	Supervisor(s)	Advisee institution (if not EPFL)
Bustarret, Gil Michel (GC-MA1)	Projet de systèmes civils: Modeling of CO2 storage in saline aquifers bounded by low permeability faults	GC-MA2	**Laloui**, Lyesse (LMS)		
Carpaij, René (GC-MA3)	Projet de systèmes civils: Thermo-hydro-mechanical modeling of nuclear waste storage	GC-MA3	**Laloui**, Lyesse (LMS)		

Cousin, Benoît Claude Henri (GC-MA1)	Projet de systèmes civils: The equivalent pier method for energy pile groups	GC-MA1	**Laloui**, Lyesse (LMS)		
Duparc, Thibaut (GC-MA1)	Laboratoire GC: « Increase in shear strength of sand treated with bio-polymer »	GC-MA1	**Laloui**, Lyesse (LMS)		
Hartmann, Pia Stephanie (GC-MA3)	Projet de construction: The equivalent pier method for energy pile groups	GC-MA3	**Laloui**, Lyesse (LMS)		
Kaufmann, Lea Tabea (GC-MA1)	Projet de construction: Sujet sur proposition de l\'étudiant	GC-MA1	**Laloui**, Lyesse (LMS)		
Martyniak, Valentin (GC-H)	Projet de construction: Etude du comportement viscoplastique d'une argilite	GC-H	**Laloui**, Lyesse (LMS)		
Martyniak, Valentin (GC-H)	Projet de systèmes civils: Modeling of fault reactivation due to CO2 storage in deep saline formations	GC-H	**Vilarrasa Riano**, Victor (LMS)		
Martyniak, Valentin (GC-H)	Laboratoire GC: Monitoring of near-surface hydraulic fracturing	GC-H	**Laloui**, Lyesse (LMS) ; **Makhnenko**, Roman (LMS)		
Melot, Geoffroy (GC-H)	Projet de systèmes civils: Modeling of CO2 storage in saline aquifers bounded by low permeability faults	GC-H	**Laloui**, Lyesse (LMS) ; **Vilarrasa Riano**, Victor (LMS)		
Melot, Geoffroy (GC-H)	Laboratoire GC: Monitoring of near-surface hydraulic fracturing	GC-H	**Laloui**, Lyesse (LMS) ; **Makhnenko**, Roman (LMS)		
Taha, Hani (GC-MA3)	Projet de systèmes civils: Thermo-hydro-mechanical modeling of nuclear waste storage	GC-MA2	**Laloui**, Lyesse (LMS)		
Taha, Hani (GC-MA3)	Projet de construction: Development of an analytical model for analysing the thermal-	GC-MA3	**Laloui**, Lyesse (LMS)		

	induced mechanical behaviour of energy piles				
Taha, Hani (GC-MA3)	Projet interdisciplinaire à option: Etude de la faisabilité de parkings souterrains échangeurs d'énergie	GC-MA3	**Laloui**, Lyesse (LMS)		

Other student projects (completed in 2015, direct link to Infoscience)

Empty category

Other supervisions

Advisee	Type of supervision	Work topic	Starting (month/year)	End, if known (month/year)	Supervisor(s)	Advisee institution (if not EPFL)
Brede, Swann	Apprenticeship	3nd year apprentice, laborant en physique	08/2013	07/2017	**Laloui**, Lyesse (LMS) ; **Dubey**, Patrick (LMS)	
Lotrecchiano, Michela (LMS)	Apprenticeship	Apprenti employé de commerce	08/2014	08/2017	**Laloui**, Lyesse (LMS) ; **Turielle**, Rosa Ana (LMS)	
Pasquier, Bastien	Apprenticeship	4rd year apprentice, laborant en physique	08/2011	07/2015	**Laloui**, Lyesse (LMS) ; **Gruaz**, Gilbert (LMS)	
Rodriquez, Gaia (LMS)	Internship	Master thesis: An experimental study on the collapse upon wetting of unsaturated volcanic ash, visiting master student	05/2015	07/2015	**Laloui**, Lyesse (LMS) ; **Ferrari**, Alessio (LMS)	
Salmi, Andrea (LMS)	Internship	Master thesis: Characterisation of Organic Matter within the oil-shales, visiting master student	05/2015	12/2015	**Laloui**, Lyesse (LMS) ; **Ferrari**, Alessio (LMS)	
		Experimental testing of soils and				

Venuleo, Sara (LCH)	Internship	on energy geostructures in partially saturated media, visiting master student	05/2015	08/2015	**Laloui**, Lyesse (LMS)	
Waymann, Guillaume	Internship	Assessment of suction measurements techniques	04/2015	07/2015	**Laloui**, Lyesse (LMS) ; **Minardi**, Alberto (LMS)	

Research

Funded and submitted research projects

Project Title	Principal Investigator	Co-applicant	Funding Source	Amount (CHF)	Start Date	Duration (Months)	Status
Thermo-mechanical performance of energy pile groups	LALOUI Lyesse		Divers Confédération	180,000 out of 180,000	01.01.2016	36	Granted
TERRE - Training Engineers and Researchers to Rethink geotechnical Engineering for a low carbon future	Tarantino Alessandro		Excellent Science	371,318 out of 4,745,934	01.11.2015	48	Granted
Thermo-mechanical performance of energy piles group	LALOUI Lyesse		FNS-Basic research	166,038 out of 166,038	01.04.2015	31	Granted
CAPROCK_Evaluation expérimentale de la géomécanique de la séquestration profonde du dioxyde de carbone	LALOUI Lyesse	Makhnenko Roman	Divers Confédération	103,000 out of 103,000	01.12.2014	32	Ongoing
Publication « Eaux souterraines et changements climatiques »	LALOUI Lyesse	Tacher Laurent	Divers Confédération	8,000 out of 8,000	01.12.2014	6	Ongoing
Geo-mechanical investigations of bio-improved soils	LALOUI Lyesse	BERNIER-LATMANI Rizlan	FNS-Basic research	176,401 out of 181,401	01.09.2014	38	Ongoing
GREAT - Geotechnical and geological responses to climate change: exchanging approaches and technologies on a worl-wide scale	Ferrari Alessio	LALOUI Lyesse	People	153,720 out of 1,078,560	01.01.2014	48	Ongoing
SoE - Supply of Electricity	Giardini Domenico	Lehning Michael; SCHLEISS ANTON; Perona Paolo; AVELLAN François; LALOUI	CTI / KTI	206,250 out of 12,000,000	01.11.2013	38	Ongoing

		Lyesse					
Geothermal Reservoir Processes: Towards the implementation of research into the creation and sustainable use of Enhanced Geothermal Systems	Maréchal François	LALOUI Lyesse	ETH Domain	30,000 out of 1,000,000	01.02.2013	36	Ongoing
Hydro-mechanical damage model for anisotropic shales (Opalinus Clay): Constitutive modelling and numerical implementation	LALOUI Lyesse		Divers Confédération	210,000 out of 210,000	01.02.2013	36	Ongoing
Experiments and Analyses of Cylindrical Wave Propagation across Rock Fractures	ZHAO Jian	LALOUI Lyesse	FNS-Basic research	191,180 out of 191,180	01.04.2012	36	Ongoing

Funded equipments

Empty category

Awards

Awardee	Name of prize / Competition	Place / Organization	Award description / URL
Grangier, Samuel (LMS)	Prix Stucky	STUCKY Ltd	http://actu.epfl.ch/news/samuel-grangier-obtient-le-prix-stucky-pour-son--3/

Research facilities

Empty category

Publications & Presentations

Journal articles (direct link to InfoScience)

Data	Peer reviewed	Key
Mimouni T., Laloui L., ***Behaviour of a group of energy piles***, in Canadian Geotechnical Journal, vol. 52, num. 12, p.1913-1929	✓	
Dieudonné A.-C., Cerfontaine B., Collin F., Charlier R., ***Hydromechanical modelling of shaft sealing for CO2 storage***, in Engineering Geology, vol. 193, p.97-105	✓	
Della Vecchia G., Dieudonné A.-C., Jommi C., Charlier R., ***Accounting for evolving pore size distribution in water retention models for compacted clays***, in International Journal for Numerical and Analytical Methods in Geomechanics, vol. 39, num. 7, p.702-723	✓	
Cerfontaine B., Dieudonné A.-C., Radu J.-P., Collin F., Charlier R., ***3D zero-thickness coupled interface finite element: Formulation and application***, in Computers and Geotechnics, vol. 69, p.124-140	✓	
Zou Y., Li J.., He L.., Laloui L., Zhao J., ***Wave propagation in the vicinities of rock fractures under obliquely incident wave***, in Rock Mechanics and Rock Engineering	✓	
Makhnenko R. Y.., Harvieux J., Labuz J. F.., ***Paul-Mohr-Coulomb failure surface of rock in the brittle regime***, in Geophysical Research Letters, vol. 42, num. 17, p.6975-6981	✓	
Rinaldi A. P.., Vilarrasa V., Rutqvist J., Cappa F., ***Fault reactivation during CO2 sequestration: Effects of well orientation on seismicity and leakage***, in Greenhouse Gases-Science And Technology, vol. 5, num. 5, p.645-656	✓	
Di Donna A., Ferrari A., Laloui L., ***Experimental investigations of the soil-concrete interface: physical mechanisms, cyclic mobilisation and behaviour at different temperatures***, in Canadian Geotechnical Journal	✓	
Vilarrasa V., Carrera J., ***Geologic carbon storage is unlikely to trigger large earthquakes and reactivate faults through which CO2 could leak***, in Proceedings Of The National Academy Of Sciences Of The United States Of America, vol. 112, num. 19, p.5938-5943	✓	
Vilarrasa V., Rutqvist J., Rinaldi A. P., ***Thermal and capillary effects on the caprock mechanical stability at In Salah, Algeria***, in Greenhouse Gases-Science And Technology, vol. 5, num. 4, p.449-461	✓	
Vilarrasa V., Carrera J., ***Reply to Zoback and Gorelick: Geologic carbon storage remains a safe strategy to significantly reduce CO2 emissions***, in Proceedings Of The National Academy Of Sciences Of The United States Of America, vol. 112, num. 33, p.E4511-E4511	✓	
Comodromosa E., Papadopouloua M., Laloui L., ***Contribution to the design methodologies of piled raft foundations under combined loadings***, in Canadian Geotechnical Journal	✓	
Parisio F., Semat S., Laloui L., ***Constitutive analysis of shale: a coupled damage plasticity approach***, in International Journal of Solids and Structures, vol. 75-76, p.88-98	✓	
Li C., Laloui L., Barès P., ***A hydromechanical approach to assess CO2 injection-induced surface uplift and caprock deflection***, in Geomechanics for Energy and the Environment, vol. 4, p.51-60	✓	
Rosone M., Airò Farulla C., Ferrari A., ***Shear strength of a compacted scaly clay in variable saturation conditions***, in Acta Geotechnica -Springer Verlag-		

Rotta Loria A. F., Orellana Espinoza L. F., Minardi A., Fuerbringer J.-M., Laloui L., ***Predicting the axial capacity of piles in sand***, in Computers and Geotechnics, vol. 69, p.485–495	✓	
Makhnenko R. Y.., Labuz J. F.., ***Dilatant hardening of fluid-saturated sandstone***, in Journal Of Geophysical Research-Solid Earth, vol. 120, num. 2, p.909-922	✓	
Di Donna A., Laloui L., ***Numerical analysis of the geotechnical behaviour of energy piles***, in International Journal For Numerical And Analytical Methods In Geomechanics, vol. 39, num. 8, p.861-888	✓	
Vilarrasa Riano V., Laloui L., ***Potential fracture propagation into the caprock induced by cold CO2 injection in normal faulting stress regimes***, in Geomechanics for Energy and the Environment, vol. 2, p.22-31	✓	
Mimouni T., Laloui L., ***Behaviour of a group of energy piles***, in Canadian Geotechnical Journal, vol. 52, num. 12, p.1913 - 1929	✓	
Batini N., Rotta Loria A. F.., Conti P., Testi D., Grassi W., Laloui L., ***Energy and geotechnical behaviour of energy piles for different design solutions***, in Applied Thermal Engineering, vol. 86, p.199-213	✓	
Bandara S., Soga K., ***Corrigendum to "Coupling of soil deformation and pore fluid flow using material point method" [Comp. Geotech. 63(1) (2015) 199–214]***, in Computers And Geotechnics, vol. 65, p.302-302	✓	
Rotta Loria A. F.., Gunawan A., Shi C., Laloui L., Ng C. W. W., ***Numerical modelling of energy piles in saturated sand subjected to thermo-mechanical loads***, in Geomechanics for energy and the environment, vol. 1, p.1-15	✓	
Di Donna A., Laloui L., ***Response of soil subjected to thermal cyclic loading: experimental and constitutive study***, in Engineering Geology -Amsterdam-, vol. 190, p.65-76	✓	
Rotta Loria A. F.., Di Donna A., Laloui L., ***Numerical study on the suitability of centrifuge testing for capturing the thermal-induced mechanical behavior of energy piles***, in Journal of Geotechnical and Geoenvironmental Engineering	✓	
Ng W..W.. C.., Shi C., Gunawan A., Laloui L., Hanlong L.., ***Centrifuge modelling of heating effects on energy pile performance in saturated sand***, in Canadian Geotechnical Journal, vol. 8, num. 52, p.1045 - 1057	✓	
Stähli M.., Sättele M.., Huggel C.., McArdell B..W.., Lehmann P.., Van Herwijnen A.., Berne A., Schleiss M.., Ferrari A., Kos A.., Or D.., Springman S..M.., ***Monitoring and prediction in Early Warning Systems (EWS) for rapid mass movements***, in Natural Hazards and Earth System Sciences, vol. 15, num. 4, p.905-917	✓	
Mimouni T., Iei L., Laloui L., ***Estimating soil thermal diffusivity with interference analyses***, in Acta Geotechnica -Springer Verlag-, vol. 10, p.197–208	✓	

Conference papers (direct link to InfoScience)

Data	Peer reviewed	Key
Terzis D., Laloui L., *Editor(s):Rinaldi V., Marcelo Z., Claria J. J.*, ***Effect of treatment on the microstructural characteristics of bio-improved sand***, 6th International Symposium on Deformation Characteristics of Geomaterials, Buenos Aires, Argentina, November 15-18, 2015	✓	
Favero V., Ferrari A., Laloui L., ***Hydro-mechanical Behaviour of Reconstituted and Intact Shales***, Second EAGE Workshop on Geomechanics and Energy, Celle, Germany, 13-15 Octobre 2015	✓	

Rotta Loria A. F., Laloui L., ***The role of null point movements on the thermo-mechanical analysis of energy piles***, 1st International Conference on Geo-energy and Geo-environment, GeGe 2015, Hong Kong, China, December 4-5, 2015	✓	
Rotta Loria A. F., Laloui L., ***Thermo-mechanical analysis of energy piles through numerical and centrifuge tests***, XV Pan-American Conference on Soil Mechanics and Geotechnical Engineering, Buenos Aires, Argentina, November 15-18, 2015	✓	
Rotta Loria A. F., Laloui L., ***Numerical study on the thermo-mechanical interactions of a group of energy piles under cooling loads***, International Symposium on Energy Geotechnics, SEG 2015, Barcelona, June 2nd-4th 2015	✓	
Qiao Y., Ferrari A., Laloui L., Ding W..Q.., ***Sensitive THM coupled analysis of buffer-rock barriers for nuclear waste storage***	✓	
Ferrari A., Seiphoori A., Laloui L., *Editor(s):Chen Z.*, *Wei C.*, *Sun D.´a.*, *Xu X.*, ***Hydro-mechanical behaviour of shot-clay bentonite***, 6th Asian-Pacific Conference on Unsaturated Soils, Guillin, China, October, 24-26, 2015	✓	
Laloui L., Ferrari A., Favero V., *Editor(s):Zhenghan C.*, *Wei C.*, *Sun D.'a.*, *Xu X.*, ***Testing of the hydro-mechanical behaviour of shales***, 6th Asian-Pacific Conference on Unsaturated Soils, Guillin, China, October, 24-26, 2015	✓	
Crisci E., Ferrari A., Urciuoli G., ***Collapse-upon-wetting behaviour of a volcanic soil***, International Workshop on Volcanic Rocks and Soils, Lacco Ameno, Ischia Island, Italy, September 24-25, 2015	✓	
Fern J., Eichenberger J., Ferrari A., Laloui L., *Editor(s):Wu W.*, ***One-Dimensional Transient Analysis of Rainfall Infiltration in Unsaturated Volcanic Ash***, Workshop on Recent Developments in the Analysis, Monitoring and Forecast of Landslides and Debris Flow	✓	

Presentations & Talks (direct link to InfoScience)

Data	Key
Cassini E. A., ***A multi-scale approach to derive a constitutive understanding of the MX-80 bentonite***, E(ngineered) B(arrier) S(ystem) Task Force, 21st meeting, EPF Lausanne, Switzerland, November 10, 2015	
Laloui L., ***Analysis of Groups of energy piles***, 1st International Conference on Geo-energy and Geo-environment, GeGe 2015, Hongkong, China, December 04-05, 2015	
Laloui L., ***Adaptation of energy Geostructures to hot-arid and –semi-arid climates***, Abu Dhabi International Research and Development Conference and Exhibition, ADARC 2015, Abu Dhabi - United Arab Emirates, May 24-26,2015	
Rotta Loria A. F., Laloui L., ***The role of null point movements on the thermo-mechanical analysis of energy piles***, First International Conference on Geo-energy and Geo-environment, GeGe 2015, Hong Kong, China, December 04-05, 2015	
Rotta Loria A. F., Laloui L., ***Thermo-mechanical analysis of energy piles through numerical and centrifuge tests***, XV Pan-American Conference on Soil Mechanics and Geotechnical Engineering, XV PCSMGE 2015, Buenos Aires, Argentina, November 15-18,2015	
Rotta Loria A. F., Laloui L., ***Thermo-mechanical interactions of a group of energy piles subjected to heating loads***, International Symposium on Energy Geotechnics, SEG 2015, Barcelona, Spain, June 02-04, 2015	
Favero V., ***Hydro-mechanical behaviour of reconstituted and intact shales***, Second EAGE Workshop on Geomechanics and Energy, Celle, Germany, October 13-15, 2015	

Favero V., ***On the Mechanical Behaviour of Reconstituted and Intact Shales***, Clay Conference, Bruxelles, March 25, 2015	
Laloui L., Ferrari A., Favero V., Minardi A., Makhnenko R., ***Multiphysical Behaviour of Shales***, International Symposium on Energy Geotechnics, Barcelona, June 2-4, 2015	
Marschall P., Giger S., Ferrari A., Favero V., Laloui L., Keller L., ***The origin of strength of Opalinus Clay: phenomenological evidence and conceptual considerations***, 6th international conference on "Clays in natural and engineered barriers for radioactive waste confinement", Brussels, March 23-26, 2015	
Favero V., Ferrari A., Marschall P., Laloui L., ***On the Mechanical Behaviour of Reconstituted and Intact Shales***, 6th international conference on "Clays in natural and engineered barriers for radioactive waste confinement", Brussels, March 23-26, 2015	

Theses (direct link to InfoScience)

Data	Key
Manca D., *Advisor(s): Laloui L., Ferrari A.*, ***Hydro-chemo-mechanical characterisation of sand/bentonite mixtureswith a focus on the water and gas transport properties***, Thèse EPFL, n° 6790	

Outreach

Current ongoing collaborations

Partner type	People involved in lab	Partner(s)	Project topic/Description, Financial support (CHF) if any	Collaboration includes...
Governmental agencies	**Laloui**, Lyesse (LMS)	SWISSTOPO	Hydro-mechanical modelling of the Opalinus Clay in Mont Terri	
Governmental agencies	**Laloui**, Lyesse (LMS)	Swiss Federal Office of Energy SFOE	Geomechanical investigation of caprock for CO2 storage; Geotechnical Reliability of Thermo-piles-energy Investigation	
Governmental agencies	**Laloui**, Lyesse (LMS)	Federal Office for the Environment FOEN		joint publication(s)
Governmental agencies	**Laloui**, Lyesse (LMS)	Swiss Federal roads office FEDRO	Use of energy geostructures for thermal regulation and energy optimization of road network and structures	
Industry & Private sector	**Laloui**, Lyesse (LMS)	Swissnuclear	Constitutive modelling of bentonite	
Industry & Private sector	**Laloui**, Lyesse (LMS)	EOS Holding	Geosturcture In-situ Test	
Industry & Private sector	**Laloui**, Lyesse (LMS)	Swiss Competence Center for Energy Research – Supply of Electricity (SCCER-SoE)	Geothermal energy and CO2 storage	
Industry & Private sector	**Laloui**, Lyesse (LMS) ; **Ferrari**, Alessio (LMS)	Sharc II consortium	Advanced testing and modelling of shales	
Industry & Private sector	**Laloui**, Lyesse (LMS) ; **Ferrari**, Alessio (LMS)	NAGRA	Experimental and constitutive analysis of the Opalinus Clay shale	
Industry & Private sector	**Laloui**, Lyesse (LMS) ; **Ferrari**, Alessio (LMS)	CHEVRON	Geomechanical characterization of gas shales	

EPF Domain	**Laloui**, Lyesse (LMS) ; **Tacher**, Laurent (LMS)	Competence Center Energy and Mobility	Geothermal reservoir behaviour	

Innovation

Empty category

Distinguished work

Empty category

Appointments at other institutions

Name	Title	Institution
Ferrari, Alessio (LMS)	Visiting Professor	Department of Civil Engineering, Indian Institute of Technology Bombay (World Universities)
Laloui, Lyesse (LMS)	Adjunct professor	School of Civil and Environmental Engineering, Duke University, USA (World Universities)

Visiting scholars

Visitor	Home Institution	Aim of visit, Duration
Al-Khoury, Rafid	Delft University of Technology, The Netherlands (European Universities)	Visit and seminar: Computational Geoenvironment: Background, Challenges and Approaches. Visit duration: Aug. 10-12, 2015
Caicedo, Bernardo	Universidad de Los Andes, Colombia (World Universities)	Visit and seminar: The problem of soil atmosphere interaction and the effect of cracks in soil deposits. Visit duration: Nov. 30- Dec. 6, 2015
El Youssoufi, Moulay Saïd	Université de Montpellier, France (European Universities)	Visit activity: Couplage multi-phyisique dans les milieux granulaires ; approche micromécanique du comportement de milieux granulaires cohésifs. Visit duration: Dec. 12-20, 2015
Klubertanz, Georg	Swiss Federal Institute of Intellectual Property (Swiss Universities and Research Centers)	Continuing Education: Effects of Salt Precipitation on the Mechanical and Hydraulic Process during CO2 Sequestration. Visit duration: Jul. 2014 - Jan. 2015
Manhal, Sirat	Applied Research and Development (AR&D) Division - Abu Dhabi Company for Onshore Oil Operations (Private sector)	Visit and seminar: Diagnosis of a Fault Seal Breach in Fractured Carbonate Reservoirs of Onshore Abu Dhabi Using 3D Geomechanical Modeling, Visit duration: May 5-7, 2015
Mohamed, Eldessouki	Technical University of Liberec (World Universities)	Visit and seminar: Modeling The Coupled Heat And Moisture Transfer In Hygroscopic Porous Structures. Visit duration: Feb. 2015
Sanchez, Marcelo	Texas A&M University, USA (World Universities)	Visit and seminar: Energy and Environmental Geomechanics: Challenges and Opportunities. Visit duration: Aug. 2015

Santamarina, J. Carlos	King Abdullah University of Science & Technology, Saudi Arabia (World Universities)	Visit and Seminar of Civil Engineering Seminar Series: Energy Geotechnology – Enabling New Insights Into Soil Behavior. Visit duration: Sep. 24-26, 2015
Souli, Hanène	National Engineering School of Saint-Étienne, France (European Universities)	Visit and seminar: Effects of particles migration on the properties of some geomaterials (clays and granular materials). Visit duration: Sep. 20, 2015

Alumni

Empty category

Distinguished alumni

Alumnus	Achievement / Distinction
Grangier, Samuel (LMS)	Samuel Grangier obtient le Prix Stucky pour son travail de Master réalisé au sein du Laboratoire de Mécanique des Sols (LMS). Sa thèse intitulée "Glissement-coulée de Pont-Bourquin (CH) : analyse du comportement hydro-mécanique de l'instabilité et des risques associés" a convaincu le jury de part son originalité (travail novateur sortant du cadre des études) et sa faisabilité (travail économiquement réaliste et pratiquement utile).

Organisation of events

Date (month)	Location	Event title	Key people in lab involved	Description / URL
12/2015	Hong Kong	1st International Conference on Geo_Energy and Geo_Environment (GeGe2015)	**Laloui**, Lyesse (LMS)	http://gege2015.ust.hk/home.htm
04/2015	Lausanne, Switzerland	13th Conference on Greenhouse Gas Control Technologies	**Laloui**, Lyesse (LMS)	The 13th Greenhouse Gas Control Technologies Conference (GHGT) is awarded to Switzerland and will be hosted by the Swiss Federal Institute of Technology (EPFL) in Lausanne in November 2016. Link to the conference page: http://www.ghgt.info/ghgt-13
10/2015	Celle	2nd International Workshop on Geomechanics and Energy - the Ground as Energy Source and Storage	**Laloui**, Lyesse (LMS) ; **Ferrari**, Alessio (LMS)	https://www.eage.org/event/?eventid=1250

Invitation to Events

Date (month)	Location	Event title	Key people in lab involved	Role / Talk title	Description / URL
		1st International		Keynote lecture: Analysis	

12/2015	Hong Kong	Conference on Geo-energy and Geo-environment, GeGe 2015	**Laloui**, Lyesse (LMS)	of Groups of Energy Piles	
11/2015	Buenos Aires, Argentina	Sixth International Symposium on Deformation Characteristics of Soils	**Laloui**, Lyesse (LMS)	Keynote lecture: Multiphysical Behaviour of Shales	
10/2015	Celle, Germany	EAGE Geomechanics and Energy workshop	**Laloui**, Lyesse (LMS)	Keynote lecture: Geomechanical solutions for Geo-Energy issues	
05/2015	Prague, Czech Republic	Prague Geotechnical Days 2015	**Laloui**, Lyesse (LMS)	Keynote lecture: Analysis of a volcanic ash slope subjected to wetting and drying cycles	
03/2015	ETH Zurich, Switzerland	Geothermal Friday Seminar, Earth Sciences	**Li**, Chao (LMS)	Carbon Dioxide Injection into Deep Aquifers: a Geomechanical Perspective	
07/2015	Cambridge University, Cambridge Cambridge – United Kingdom	COST ACTION GABI TU1405	**Rotta Loria**, Alessandro (LMS)	Thermo-mechanical interactions of a group of energy piles subjected to heating loads	
03/2015	Abu-Dhabi, United Arab Emirates	Bio-cemented sands: microstructural characteristics and mechanical response	**Terzis**, Dimitrios (LMS)	Bio-cemented sands: microstructural characteristics and mechanical response	
05/2015	Hochschule Luzern	Journée d'étude de Geotechnique Suisse, Méthodes de confortation en géotechnique	**Terzis**, Dimitrios (LMS)	Amélioration des sols par la bio-minéralisation de la calcite	

Services

EPFL committees and services

Name	Service	Role	Role in funding allocation
Laloui, Lyesse (LMS)	Civil Engineering Section	Director	yes
Laloui, Lyesse (LMS)	Direction of the School of Architecture, Civil and Environmental Engineering (ENAC)	Member	yes
Laloui, Lyesse (LMS)	Committee of the Doctoral Program in Mechanics	Member	no
Laloui, Lyesse (LMS)	Faculty search committee for position of Professor in Rock Mechanics at EPFL	Chairman	no
Laloui, Lyesse (LMS)	Faculty search committee for position of Professor in Geo-Energy at EPFL	Chairman	no
Laloui, Lyesse (LMS)	Faculty search committee for position of Professor in Structures & Materials	Member	no
Laloui, Lyesse (LMS)	Faculty search committee Professor position in “Renewable Energy in Buildings”	Member	no
Laloui, Lyesse (LMS)	ENAC Academic Promotion Comittee CPA	Member	no
Laloui, Lyesse (LMS)	Faculty Search Committee for two positions of Professor in Transportation engineering and Transportation systems at EPFL	Member	no

Other committees and services (national including the EPF domain, international...)

Name	Service	Role	Role in funding allocation
Ferrari, Alessio (LMS)	International Society of Soil Mechanics and Geotechnical Engineering ISSMGE	Member of the technical committee TC 308 “Energy Geotechnics”	no
		Member of the	

Ferrari, Alessio (LMS)	International Society of Soil Mechanics and Geotechnical Engineering ISSMGE	technical committee TC 101 “Unsaturated Soils”	no
Ferrari, Alessio (LMS)	Fifth EAGE shale workshop, Catania, Sicily, Italy	Member of the Scientific Committee	no
Ferrari, Alessio (LMS)	Second EAGE Workshop on Geomechanics and Energy	Member of the Scientific Committee	no
Laloui, Lyesse (LMS)	Geomechanics and Geomaterials – Hermes Science Publishing Limited (WILEY-ISTE, London)	Book Series Editor	no
Laloui, Lyesse (LMS)	Acta Geotechnica	Member of Editorial Board	no
Laloui, Lyesse (LMS)	Chinese Journal of Geotechnical Engineering	Member of Editorial Board	no
Laloui, Lyesse (LMS)	European Journal of Environmental and Civil Engineering	Member of Editorial Board	no
Laloui, Lyesse (LMS)	Journal of Coupled Systems and Multiscale Dynamics	Member of Editorial Board	no
Laloui, Lyesse (LMS)	Environmental Geotechnics	Advisory Board Member	no
Laloui, Lyesse (LMS)	International Journal for Numerical and Analytical Methods in Geomechanics	Member of Editorial Board	no
Laloui, Lyesse (LMS)	Sixth International Symposium on Deformation Characteristics of Geomaterials Buenos-Aires, Argentina 2015	Member of the International Advisory Committee	no
Laloui, Lyesse (LMS)	VI International Conference on Computational Methods for Coupled Problems in Science and Engineering (COUPLED PROBLEMS 2015), 18 - 20 May 2015, Island of San Servolo, Venice, Italy	Member of the Scientific Committee	no
Laloui, Lyesse (LMS)	TC101 “Laboratory Stress Strain Strength - Testing of Geomaterials” of the International Society for Soil Mechanics and Geotechnical Engineering.	Vice-Chair	no
Laloui, Lyesse (LMS)	Faculty Search Committee for position of Full Professor in Geotechnical Engineering at EHT Zurich	Member	no
Laloui, Lyesse (LMS)	EU-ERC Consolidator Grants panel dealing with Products and Processes Engineering	Member	yes

Laloui, Lyesse (LMS)	International journal Geomechanics for Energy and the Environment	Editor-in-Chief	no
Laloui, Lyesse (LMS)	Second EAGE Workshop on Geomechanics and Energy	Chairman	no
Laloui, Lyesse (LMS)	Scientific Committee of the International Conference on Computational Methods for Coupled Problems in Science and Engineering (COUPLED PROBLEMS 2017, Island of Rhodes (Greece), 2017.	Member	no
Laloui, Lyesse (LMS)	International technical committee of the PanAm-UNSAT 2017: The 2nd Pan American Conference on Unsaturated Soils, Dallas/Fort Worth, Texas, USA, 2017.	Member	no
Laloui, Lyesse (LMS)	Scientific committee of the 7th Clay Conference (Clays in Natural and Engineered Barriers for Radioactive Waste Confinement) Davos, 2017.	Member	no
Laloui, Lyesse (LMS)	International Advisory Committee of the Third European Conference on Unsaturated Soils (E-UNSAT2016) in Paris, France.	Member	no

Vision

Highlights

Highlights
High level of scientific production with more than 20 publications in international peer-review journals in 2015 We organized 3 international conferences and celebrated the 80th anniversary of the geotechnical group of EPFL. We are organizing the 13th Greenhouse Gas Control Technologies Conference (November 2016).

Goals

Goals
The LMS activities are designed to promote engineering solutions in the field of the alternative sources of energy, including nuclear waste disposal, geothermal energy and CO2 sequestration. The LMS activities will continue to cover education, research and technology transfer in the large field of Geomechanics. The vision aims at contributing to a sustainable development of our built and natural environment by addressing selected key questions with the highest possible academic standard, within transdisciplinary internal and international collaborations and through contacts with industry with long-term research focuses. The research activities will focus on problems involving a variable environment and new and advances in existing technologies of energy production. These two areas: environment and energy are expected to dominate technological agenda for forthcoming years. The reason for that is two-fold: first there is world-wide crisis of environment endangerment related to the geosphere: soil and groundwater pollution by accidental spills, CO2 emission driven reduction of fossil fuel usage and/or inadequate isolation of pollutants, and second there is a host of new sources of energy related to geosphere. In both cases, there is an emerging new fundamental research concerning the effects of chemical, thermal and biological variables on mechanical properties and mechanical variables of soils and shales, and vice versa the effects of mechanical variables as stress, strain, damage affecting chemical and biological, physical or thermal processes and properties that require a multi-disciplinary approach. The levels of these couplings are multiple and often poorly recognized. Especially with nascent technologies related to the energy production it is rational to include the environmental considerations early in the phase of development rather than seek remedies post factum, or after the damage has been induced. This clearly may refer to production of natural gas from shales, the techniques of hydraulic and chemical fracturing, CO2 sequestration technologies, nuclear waste isolation (long and short term), heat and fuel storage in the underground and under structures, geothermal fluid energy, energy from methane hydrates, oil production from high temperature, high pressure deposits, and many others. Effects of chemical and biological pollution on isolation geo-structures constitute a separate class of problems. Finally, technologies of chemical and biological improvement of mechanical and hydraulic quality of soils and shales involve knowledge and methods based on the same principles. The intrinsic nature of coupling of chemical, biological, thermal and mechanical properties, variables and fields distinguishes the related problems from those in classical geomechanics. It is believed that continuing and establishing new research activities dedicated to these issues of Energy and Environmental Geomechanics is a great opportunity for LMS and ENAC. Some examples of activities for the coming years would be in the following areas: Geo-energy structure

Efforts are being devoted to better understand the physical mechanisms and phenomena characterising the operation of energy geostructures for ensuring an optimal geotechnical, structural and energy performance of such ground structures. The LMS has nowadays more than 10 years of experience on this scope and is internationally recognised by Universities and Companies as the leader research group in this field. The analyses that are being performed are focused on various aspects that characterise energy geostructures, including the non-isothermal behaviour of soils when subjected to cyclic temperature variations, the interaction (soil-structure) with the concrete composing these ground structures, the structural behaviour of the concrete itself subjected to temperature changes, the hydraulic aspects related to the fluid flow inside of the pipes embedded in the concrete that allow for the heat exchange between the soil and the ground structure, and the optimal practices for equipping the considered elements. It is considered that the exploitation of shallow geothermal energy for satisfying the energy needs of building environments in an environmentally-friendly way will increase and spread worldwide more and more in the foreseeable future. The LMS, through its expertise in this subject matter, aims at being the representative of this revolutionary approach.

Deep Geo-Energy

Advanced theoretical, experimental and computational knowledge was developed in the recent years at the LMS for assessing and predicting the behaviour of geomaterials subjected to changes in temperature and at different states of saturation. This state of the art expertise has been mainly applied in the fields of underground nuclear waste storage as well as the geothermal use of the building foundations. The research activities are now devoted to (i) the enhancement of the understanding of the thermo-hydro-chemical-mechanical behaviour of shales (including gas shales and host rock formations for waste disposal) and bentonites and the prediction of their long term behaviour, and (ii) the development of computational design tools for geo-energy structures.

Several highly sophisticated and unique experimental tools were developed at the lab in the recent three years with an investment of about 1000.- Kfrs (from FNS, EPFL and industry). It is planned to develop the knowledge and the understanding on the behaviour of soils and shales in the light of the extreme loading conditions that the equipment allows. There is a huge room for fundamental research on the running of coupled thermo (until 150°C) –hydro (until 400 MPa of suction)-mechanical (until 30 MPa) testing as well as on the behaviour of the materials in such conditions. I would like also to extend the laboratory facilities serving the research to micro scale observations (i.e. neutron tomography) for a better insight on the fundamental physical mechanism governing the thermo-hydro-mechanical behaviour of the involved materials.

Environmental Geomechanics

Efforts will be devoted to maintain the current research activities in the area of multi-physical coupling processes in soils at leading edge of technology with expertise in the fundamentals of soil mechanics.

LMS has a large tradition in the domain of landslides analysis. In the past years, early warning system methods have been developed. Climate change and its effects on earth equilibria, water budget are studied all around the world by thousands of researchers. Following this trend, the current researches at LMS focus on the effects of climate variations on the stability of slopes. To do so, interactions between the soil and the atmosphere have to be studied to understand the exchanges between the two systems. Making use of the foreseen climate changes, the aims of these researches would be to take a step forward in the management of the natural hazards by predicting the situation in the next century. As dry Summers as the 2015 are more often anticipated in the 21st century, the focus will be set on the mechanism of desiccation cracking in soils. The room for research on this phenomenon is extremely important and its implications on landfill liners integrity, stability of foundations, agriculture and stability of slopes have to be assessed.

The project of bio-improved soils currently carried out at LMS has proven great potential in building a sustainable, environmental-friendly method for stabilizing soils and preventing failures in a vast range of engineering problems. The project has already offered the chance for interdisciplinary collaboration between LMS and EML and offers common ground for collaboration with other ENAC laboratories. As a foreseen step, a pilot, large-scale application of the technique is planned in order to better design and suggest an efficient method, adaptable to the needs of the geotechnical problem.

CO2 storage

The financial support of Petrosvibri to the Chair allows the development of a deep knowledge in the area of CO2 storage. Experimental facilities devoted to this topic are developed. Also computational tools at the basin scale will be introduced for the analysis of the various scenarios.

These objectives would help the ENAC to strengthen its research and teaching profile and to play an important national and an international role in the most advanced and strategically important areas of research in Energy and Environmental Geomechanics.

Others

Others
The 13th Greenhouse Gas Control Technologies Conference (GHGT) is awarded to Switzerland and will be hosted by the Swiss Federal Institute of Technology (EPFL) in Lausanne in November 2016. The 13th GHGT that will be co-organized by LMS is a perfect opportunity for the LMS to promote its innovative concepts related to greenhouse gas control and renewable energy technologies. We are hoping that hosting such a big event in Switzerland will help to enhance the participation of researchers and industrial partners from Europe and Middle East and will have a decisive impact on CCS in this regions and worldwide.

---

*Printed 15.03.2016 by **Li, Chao** (LMS)*