CIRIR programs: drilling and research opportunities at the Rochechouart Impact Structure

Conference or Workshop Item

CIRIR PROGRAMS: DRILLING AND RESEARCH OPPORTUNITIES AT THE ROCHECHOUART IMPACT STRUCTURE. P. Lambert[1] , Alwmark C.[2], Baratoux D.[3], Brack A.[4], Bruneton P.[5], Buchner E.[6], Chevremont P.[7], Claeys P.[8], Dence M.R.[9], Floch J.P.[10], French B.M.[11], Gattacceca J.[12], Gibson R.L.[13], Goderis S.[14], Grieve R.A.F.[15], Hodges K.V.[16], Hörz F.[17], Jourdan F.[18], Kelley S.P.[19], Kenkmann T.[20], Kring D.A.[21], Langenhorst F.[22], Lee M.R.[23], Lindgren P.[24], Lofi J.[25], Lorand J.P.[26], Luais B.[27], Masaitis V.[28], Meunier A.[29], Moore C.B.[30], Ormö J.[31], Osinski G.R.[32], Petit S.[33], Pohl J.[34], Quesnel Y.[35], Reeves H.[36], Rochette P.[37], Sapers H.M.[38], Schmieder M.[39], Schultz P.H.[40], Schwenzer S.P.[41], Shoemaker C.S.[42], Stöffler D.[43], Trumel H.[44], Westall F.[45], Wittmann A.[46], and Wünnemann K.[47]. [1]CIRIR-Center for International Research on Impacts and on Rochechouart- 2, Faubourg du Puy Moulin-87600 Rochechouart-France, lambertbdx@gmail.com, [2]carl.alwmark@geol.lu.se, [3]david.baratoux@get.obs-mip.fr, [4]brack@cnrs-orleans.fr, [5]p.bruneton@orange.fr, [6]Elmar.Buchner@hs-neu-ulm.de, [7]phil.chevremont@gmail.com, [8]phclaeys@vub.ac.be, [9]mrdence@rogers.com, [10]jpfloch@gmail.com, [11]FRENCHB@si.edu, [12]gattacceca@cerege.fr, [13]roger.gibson@wits.ac.za, [14]Steven.Goderis@vub.ac.be, [15]rgrieve@nrcan.gc.ca, [16]kvhodges@asu.edu, [17]fhorz@aol.com, [18]F.Jourdan@exchange.curtin.edu.au, [19]simon.kelley@open.ac.uk, [20]thomas.kenkmann@geologie.uni-freiburg.de, [21]Kring@lpi.usra.edu, [22]falko.langenhorst@uni-jena.de, [23]Martin.Lee@glasgow.ac.uk, [24]Paula.Lindgren@glasgow.ac.uk, [25]johanna.lofi@gm.univ-montp2.fr, [26]Jean-Pierre.Lorand@univ-nantes.fr, [27]luais@crpg.cnrs-nancy.fr, [28]vcmsts@mail.ru, [29]alain.meunier@univ-poitiers.fr, [30]CMoore@asu.edu, [31]ormoj@cab.inta-csic.es, [32]gosinski@uwo.ca, [33]sabine.petit@univ-poitiers.fr, [34]pohl@geophysik.uni-muenchen.de, [35]quesnel@cerege.fr, [36]nelly@hubertreeves.info, [37]rochette@cerege.fr, [38]haley.sapers@gmail.com, [39]martin@suevite.com, [40]peter_schultz@brown.edu, [41]susanne.schwenzer@open.ac.uk, [42]mrscomet3@aspect1.net, [43]dieter.stoeffler@mfn-berlin.de, [44]herve.trumel@wanadoo.fr, [45]frances.westall@cnrs-orleans.fr, [46]axel.wittmann@asu.edu, [47]kai.wuennemann@mfn-berlin.de

Introduction: Owing to its size, accessibility and erosional level, the Rochechouart impact structure [1], dated at ~203 ± 2 Ma (recalc.) [2], occupies a critical position within the population of rare terrestrial analogs to the large impacts craters observed on planetary surfaces [1-4]. The site allows direct access to researchers investigating fundamental mechanisms both in impact-related geology (origin and evolution of planets) and biology (habitability of planets, emergence and evolution of life). For the last decade P. Lambert has been promoting Rochechouart as an International Natural Laboratory for studying impact processes and collateral effects on planetary surfaces. For this purpose the Center for International Research on Impacts and on Rochechouart (CIRIR) was installed on site in 2016 with twofold objectives and activities. The first is scientific; the second is cultural and educational and dedicated to the public *sensu lato*. We present here the CIRIR, its scientific programs and the related research opportunities.

CIRIR Status: CIRIR is a public initiative of the Rochechouart regional territories in the form of an Association composed exclusively of public officials. It is entirely funded by public money. CIRIR is placed under the governance of a fully independent Director reporting to the public authorities and covering both scientific and public-oriented activities.

Scientific Objectives: The CIRIR aims at developing research on Rochechouart impact crater and on impact-related processes of planetary significance, such as the development of an impact-triggered hydrothermal cell, or the subsurface crater modification and readjustment mechanisms, that are particularly accessible and well exposed at Rochechouart impact structure.

CIRIR is initially planned as a resource facility for ground-truth data mining. It is a base camp for further field studies and a unique dynamic data/sample library. It aims at collecting and curating materials and data within the impact structure, *sensu lato*, far more than just the preserved breccia deposits marking the bottom of the initial crater, and far beyond the actual perimeter of the "Reserve Naturelle Nationale de l'Astroblème de Rochechouart-Chassenon" (NNR).

CIRIR also instigates and leads incentive measures such as the 2017 drilling campaign in/by the NNR.

Means and Programs: The CIRIR facility comprises two buildings, one for the Rochechouart sample facility and the second for accommodating visiting scientists and students including space and equipment for sample preparation and for petrologic observation.

For achieving its ambitious objectives, the CIRIR involves and coordinates both scientists and the public in a participative approach. This includes the establishment and management of a continuous and systematic sampling campaign (ground and drilling) of the greater Rochechouart structure (proximal and distal zones). Scientists, as well as landowners, local public authorities, and enterprises on site will participate in the CIRIR as providers of the "raw material", offsetting the vegetation and relative paucity of outcrops.

The CIRIR includes a small headquarters with the director on-site and a large network of collaborators

worldwide with 3 active teams plus a group of retired legendary peers of the discipline forming the "Comité des Sages" (see Table 1). All members of CIRIR are contractually linked and engaged in a common goal: the implementation of active research and/or outreach, related to materials and data collected in/on the territories affected by the impact. One team deals with the public relations, education, cultural and related activities, a second with research, and the third one is transversal and provides support to the others. The first two teams (PI teams) are composed of individuals and groups with the capacity to set up and lead independent project(s). The PIs have the discretion to design and implement their projects in full independence, but all projects comply with the group rules. They are placed under the supervision of the "Comité des Sages", and the CIRIR Director coordinates the whole exercise. All projects are visible and will benefit all members. The CIRIR headquaters provides the materials and support (coordination, administration, sample management, field assistance, including lodging and facilities on site), but does not fund projects. It is up to each PI to raise support for their project(s). In case of overlap or risk of conflict between project(s), PIs involved have agreed to group and to share tasks under the coordination of one of them.

The 2017 Drilling Campaign at Rochechouart: The first major initiative of CIRIR scientific programs is the organization and the management of the first scientific drilling campaign ever conducted at the Rochechouart impact structure. The program is endorsed and funded by the NNR [4]. Over 20 shallow drill holes targeting 350-400 m in cumulated length will be distributed over 8 sites spread along two 10 km radial traverses across the center of the structure [4]. Beyond specific issues such as initial crater size and morphology, age of impact, distal effects, characteristics of the target and of the projectile, major scientific objectives are similar to those of the 2016 drilling program at Chicxulub [5]. This includes crater formation mechanics, characterization of impact-induced alteration processes, and the evaluation of possible effects of large impacts on the habitability of planets and the emergence of life.

Conclusions and Perspectives: CIRIR and its programs are set, operational and launched. They will result in immediate research opportunities with the promises of a better understanding of Rochechouart, of large impacts and of their collateral effects on Earth and on planetary surfaces. Those interested in joining and in contributing to our programs are welcome to contact us with their expressions of interest. Practical details and projects will be further developed at the time of the conference.

References: [1] Kraut F. (1969) *Geologica Bavarica 61*: 428–450. [2] Schmieder M. et al. (2010) *MAPS 45*, 1225–1242. [3] Lambert P. (2010) *GSA Spec Pap. 465*, 505–541. [4] Lambert P. et al. (2016) MAPS , Abstract, #6471.pdf. [5] Morgan J. V. et al. (2016) *Science*, *354*, 878–882.

CIRIR-COMITE DES SAGES BOARD OF SENIOR EXPERTS, ENDORSMENT & ETHIC			
Name		**Affiliation (/ex-affiliation)**	**Nation**
Dence	Michael	Dominion Observatory-Service Géologique du Canada, Ottawa	Canada
Grieve	Richard	University of Western Ontario, London, Ontario	
Reeves	Hubert	CNRS/CEA-Paris-France	France
Brack	André	CNRS-Orléans	
Meunier	Alain	Université de Poitiers	Germany
Pohl	Jean	Ludwig-Maximilians-University, Munich	
Stöffler	Dieter	Natural History Museum-Humboldt-University, Berlin	Russia
Masaitis	Victor	Karpinskii All-Russian Geological Research Institute, St. Petersburg	
French	Bevan	Smithsonian Institution, Wahsington DC	USA
Hörz	Fred	Nasa, Johnson Space Center, Houston, Texas	
Moore	Carleton	Center for Meteorite Studies, Tempe, Arizona	
Schultz	Pete	Brown University, Providence, Rhode Island	
Shoemaker	Carolyn	US Geological Survey, Flagstaff, Arizona	

CIRIR-PI TEAM-RESERACH			
Name		**Affiliation**	**Nation**
Gibson & group	Roger	University of the Witwatersr&, Johannesburg	South Africa
Jourdan & group	Fred	Curtin University, Perth	Australia
Claeys & group	Philippe	Virje University, Brussels	Belgium
Goderis	Steven	Virje University, Brussels	
Sapers	Haley	University of Western Ontario, London, Ontario	Canada
Osinski & group	Gordon	University of Western Ontario, London, Ontario	
Baratoux	David	Université de Toulouse	France
Luais	Béatrice	CNRS-CRPG Université de Lorraine	
Quesnel	Yoann	Université Aix-Marseille	
Westall & group	Frances	CNRS-Université Orléans	
Kenkmann & group	Thomas	University of Freiburg	Germany
Langenhorst & group	Falko	University of Jena	
Wünnemann & group	Kai	Museum für Naturkunde-Humboldt Universität-Berlin	
Ormö & group	Jens	Centro de Astrobiologia Madrid	Spain
Alwmark	Carl	Lund University	Sweden
Kelley & group	Simon	Open University	UK
Lee & group	Martin	University of Glasgow	
Schwenzer	Suzanne	Open University	
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Kring & group	David	Lunar & Planetary Institute, Houston, Texas	
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Wittmann	Axel	Arizona State University,Tempe	

CIRIR-SUPPORT TEAM-RESEARCH			
Name		**Affiliation**	**Nation**
Lindgren	Paula	University of Glasgow	UK
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Chevremont	Philippe	Ex. BRGM-Service Géologique National	
Floc'h	Jean-Pierre	Ex. Université de Limoges	
Gattacceca	Jérôme	CNRS Aix-Marseille	
Lambert	Philippe	CIRIR-Rochechouart/Sciences & Applications-Bordeaux	
Lofi	Johanna	Université de Montpellier	
Lorand	Jean Pierre	Université de Nantes	
Petit et IC2MP	Sabine	Institut Chimie des Milieux et Matériaux de Poitiers (IC2MP)	
Ramboz	Claire	CNRS-Institut des sciences de la terre d'Orléans	
Rochette & group	Pierre	Université Aix-Marseille	
Trumel	Hervé	CEA-Le Ripault-Monts	
Buchner	Elmar	University of Applied Sciences Neu-Ulm	Germany

Table 1: CIRIR Scientific teams

TASKS	OPERATOR	2017	2018	2019
Autorisations, selecting drilling Cie, contracts...	NNR ("Réserve Naturelle Nationale de l'Astroblème Rochechouart-Chassenon")			
Scientific programme	P. Lambert (on behalf of NNR and public authorities)	COMPLETED		
Funding	NNR (Funding sources : Local authorities, French State, EU)	COMPLETED		
Final validation	Scientific Committee of NNR			
Realization of the drillings	Selected drilling Cie			
Call for PI's and organizing scientific valorization	CIRIR			
Set up of the research projects	Individual PI's (with CIRIR support for logistics and coordination)			
Initial examination of cores	CIRIR Support Task Force and PI's			
Sample preparation (halving, indexing, ...)	CIRIR (on behalf of NNR)			
Sample Authorizations and procedures	NNR with CIRIR assistance			
Sample distribution	CIRIR (on behalf of NNR)			
Studies	CIRIR PI's			
Public valorization	CIRIR and NNR			

Table 2 : Drilling Program Timetable