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李真博士主要基于土壤系统研究“微生物--矿物--重金属”相互作用，特别关注系统中磷元素的循环过程。在基础研究上主要解析 1) 土壤磷的微生物地球化学循环；2) 土壤微生物的环境毒理。在应用层次主要研究 1) 高效磷肥的开发；2) 基于高效磷素释放的高效土壤修复剂创制；3) 含磷固体废弃物的处理。

教育与工作经历

- 2001-2005, 南京大学地球科学系 地质学国家理科人才培养基地 理学学士
- 2005-2008, (免试保送) 南京大学地球科学系 地球探测与信息技术专业 工学硕士
- 2008.8-2013.12, 圣路易斯华盛顿大学 地球与行星科学系 哲学博士
- 2014.6-2016.12, 南京农业大学土壤与生态学系 讲师
- 2016.12- 南京农业大学土壤与生态学系 副教授

学术兼职与服务

- 美国矿物学协会 会员
- Scientific Reports 学术编委 (2016-2021)
- Goldschmidt2020 微生物-矿物-金属 会场 召集人
- 哈萨克斯坦国家科学技术评估中心外审专家
- 江苏省耕地土壤污染治理专家库专家
- 江苏省生态环境损害鉴定与评估专家

获奖经历

- 华盛顿大学 Wheeler 奖学金 (2008-2012)
- 华盛顿大学优秀助教 (2009-2010)
- 华盛顿大学毕业论文奖学金 (2013)
- 江苏双创博士计划 (2015)
- 南京市留学人员择优项目(2015)
- 全国高校农林类专业微课教学比赛一等奖(最高奖)(2017)
- 南京农业大学本科生毕业论文特等奖 指导老师(2018, 2020, 2021)
- 江苏省本科生优秀毕业论文二等奖 指导老师(2018)
- 国家精品在线开放课程“土壤、地质与生态学综合实习”地质学部分 (2018)

Curriculum Vitae of Zhen Li

- 南京农业大学优秀学生教育管理工作者(2018)
- 梅特勒-托利多全国论文比赛二等奖(2018)
- 南京农业大学本科生毕业论文一等奖指导老师 (2019)
- 研究生国家奖学金获得者指导老师 (2017, 2018, 2019)
- 全国大学生在行动—生物多样性主题调研小分队指导老师 (2020)
- 江苏省本科高校青年教师教学竞赛二等奖(2020)
- 赢在南京江北新区杯青年科技工作者创新创业大赛优秀奖(2020)
- 江苏省科协青年会员创新创业大赛三等奖(2020)
- 挑战杯江苏省一等奖项目指导老师(2021)
- 挑战杯红色专项江苏省二等奖项目指导老师(2021)
- 江苏省科技副总(2021)

主持项目

- 2015, 国家 973 重大专项子课题专题, No. 2015CB150504, ¥920, 000
- 2015, 教育部留学人员回国基金 (生物磷灰石重金属沉积), ¥35, 000
- 2015, 南京市留学人员择优项目 (基于矿物的土壤修复), ¥20, 000
- 2015, 江苏省青年基金 (土壤磷循环), No. BK20150683, ¥200, 000
- 2015, 江苏双创博士, ¥150, 000
- 2016, 南京大学内生矿床国家重点实验室开放基金, No. 21-16-07, ¥100, 000
- 2017, 中国博士后面上基金一等资助 (解磷菌), No. 2017M610330, ¥80, 000
- 2017, 中央高校基本业务费重点项目 (解磷菌), No. KYZ201712, ¥90, 000
- 2017, 江苏省大学生创新训练计划 (土壤修复), No. 201710307003P, ¥50, 000
- 2015, 横向项目, ¥550, 000
- 2017, NJAU-MSU Asia Hub, ¥330, 000
- 2018, 江苏省大学生创新训练计划 (土壤修复), No. 201810307004P, ¥50, 000

已授权国家发明专利

- 2016, 李真, 一种提高磷肥磷元素释放效率的方法, ZL2014104588239
- 2018, 李真, 一种基于粘土和磷灰石的土壤修复材料及其制备方法, ZL2014104139475
- 2018, 李真等, 一种矿物修复剂及其制备方法和应用, ZL2015108973545
- 2020, 李真等, 用于测量单细胞微生物呼吸速率的通气装置, ZL202020000911.5
- 2021, 李真等, 一种富集碳酸根的羟基磷灰石、制备其的身背、制备方法和应用, ZL201810479687.X
- 2021, 李真等, 一种生物单细胞透射电镜样品的制备方法, ZL202011282160.1

Curriculum Vitae of Zhen Li

毕业学生去向

- 2017, 本科生: 孟士婷 (保送北师大); 张俐 (日本九州大学, 全奖); 胡云潇 (卡塞尔大学)
研究生: 李桥 (华中农大读博, 协助指导)
- 2018, 本科生: 张馨玉 (保送上交大); 唐凌逸 (保送南农, 清华联培); 张帆 (南农); 马硕嘉 (上师大); 郑扬凡 (就业)
研究生: 王书杰 (南农读博, 协助指导); 段晓芳 (南大读博, 协助指导)
- 2019, 本科生: 蒋柳 (马里兰大学, 博士全奖); 吴袁依 (帝国理工); 邹湘 (保送浙大); 赖桢媛 (浙大); 郭洁芸 (保送南大); 杨梦影 (保送浙大); 田维韬 (保送复旦); 王志军 (南农); 刘树展 (就业); 彭瑾钰 (就业)
研究生: 苏慕 (南农读博, 协助指导); 蒋中权 (提前攻博); 吴义玲 (就业)
博士生: 田达 (安徽农大讲师, 协助指导); 陈颢明 (南理工讲师, 协助指导)
- 2020, 本科生: 邵晓晴 (多伦多大学, 博士全奖); 宋芯玮 (保送浙大); 张佳雯 (保送浙大); 韩飞宇 (南农); 马菁 (华南农大); 杨辉 (就业)
- 2021, 本科生: 王童 (保送浙大); 王梦晓 (保送人大); 王雪炜 (保送上交大); 马婧萱 (保送中科院); 陈天一 (保送北大); 彭超 (保送南农)
研究生: 唐凌逸 (阿尔伯塔大学读博); 张琳 (河南科技大学, 协助指导)

Below is the English version:

Zhen Li

College of Resources & Environmental Sciences

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Google Scholar: <https://scholar.google.com/citations?hl=en&user=FL3HAhMAAAAJ>

ResearchGate: http://www.researchgate.net/profile/Zhen_Li54

Publons: <https://publons.com/researcher/2222311/zhen-li/>

Employer:

- 2014.06 – 2016.12, Lecturer, Nanjing Agricultural University
- 2012.12-, Associate Professor, Nanjing Agricultural University

Education:

- Ph.D., 2008-2013, Earth and Planetary Sciences, Washington University in St. Louis
- M.E., 2005-2008, Applied Mineralogy, Nanjing University
- B.S., 2001-2005, Geology, Nanjing University

Teaching Courses:

- Academic English in Ecology
- Biogeochemistry
- Environmental Geology

Membership & Society Service:

- Member of Mineralogical Society of America
- Member of Geochemical Society
- Editor Member (in Mineralogy and Soil Sciences), *Scientific Reports*
- Convenor (session: Formation, weathering, and transportation of minerals and metals: insights from microbial functions & microbiome), Goldschmidt 2020

Awards:

- The Double Innovation Talent Program of Jiangsu Province (2015)
- Dissertation Fellowship at WUSTL (2013)
- Outstanding Performance of Teaching Assistant at WUSTL (2010)

Curriculum Vitae of Zhen Li

Oral Presentations

- 2021 July 8th, Goldschmidt, Virtual
- 2019 Sep 22nd, ENPE, Wuhan, China
- 2019 Aug 21st, Goldschmidt, Barcelona, Spain
- 2019 Aug 9th, ISEG, Beijing, China
- 2019 May 8th, ICOBTE, Nanjing, China
- 2019 May 4th, Tsinghua Forum of Environmental Remediation, Beijing, China
- 2018 Oct 12th, 2nd ISWSGS, Nanjing, China
- 2018 Aug 14th, Goldschmidt, Boston, MA, US
- 2017 Oct, 7th Agro-Environmental Sciences, Guiyang, China
- 2017 Oct, 9th NCEC, Hangzhou, China
- 2017 Mar, 1st ENPE, Nanjing, China
- 2016 Sep, 13rd Soil Society Conference, Xi'an, China
- 2014 Oct, Mineralogical Science and Engineering, Nanjing, China
- 2014 June, Goldschmidt, Sacramento, CA U.S.
- 2014 June, XI GeoRaman, Saint Louis, MO U.S.
- 2014 July, 12th ICSLR, Beijing, China

Research Interests:

- Environmental Microbiology
- Environmental Mineralogy
- Soil Remediation
- Phosphorous Biogeochemistry

Grants:

- 2020-2023, National Key R&D Program of China, ¥1,150,000
- 2020, Agricultural Soil Remediation, ¥880,000
- 2017-2019, Direction on Jiangsu Undergraduate Research, ¥150,000
- 2017, NJAU-MSU Asia Hub, ¥330,000
- 2016, Analytical fund of State Key Laboratory for Mineral Deposits Research, Nanjing University, ¥100,000
- 2015-2019, National Program on Key Basic Research Project, No. 2015CB150504, ¥900,000
- 2015, Scientific Research Foundation for the Returned Overseas Chinese Scholars, State Education Ministry, ¥35,000
- 2015, Analytical fund of CAGS, ¥90,000
- 2015, Distinguished Project for Returned Scholars, Nanjing, ¥20,000

Curriculum Vitae of Zhen Li

- 2015-2018, Natural Science Foundation of Jiangsu Province, No. BK20150683, ¥200,000
- 2015-2017, The Double Innovation Talent Program of Jiangsu Province, ¥150,000

Authorized Patents:

- [1] 2016, **Li Z.** A method of enhancing P release from apatite, ZL201410458823.9.
- [2] 2018, **Li Z.** A new material for heavy metal remediation based on apatite and clay minerals, ZL2014104139475

Representative Publications (*: Corresponding):

- [52] Shao X.Q., Hao W.D., Konhauser K., Gao Y.N., Tang L.Y., Su M., **Li Z.*** (2021) The dissolution of fluorapatite by phosphate-solubilizing fungi: a balance between enhanced phosphorous supply and fluorine toxicity. *Environmental Science and Pollution Research*, Accepted.
- [51] Jiang Z.Q., Sun D.Q., Guan H.Z., Sun Y.T., Ye M.L., Zhang L., Gu T.T., Chen J.N., Wang S.J., Zhang C.H., Wang S.M., Zhou Z.L., Ge Y.*, **Li Z.*** (2021) Transmission electron microscopy analysis on microbial ultrathin sections prepared by the ultra-low lead staining technique. *Microscopy & Microanalysis*, Accepted.
- [50] Su M., Meng L.Z., Zhao L., Tang Y.K., Qiu J.J., Tian D., **Li Z.*** (2021) Phosphorus deficiency in soils with red color: Insights from the interactions between minerals and microorganisms. *Geoderma*, 404, 115311.
- [49] Wang Z.J., Zhang Y., Jiang L., Qiu J.J., Gao Y.N., Gu T.T., **Li Z.*** (2021) Responses of *Rhodotorula mucilaginosa* under Pb(II) stress: carotenoid production and budding. *Environmental Microbiology*, accepted.
- [48] Wang S.J., Li Q., Gao Y.N., Zhou Z.L.*, **Li Z.** (2021) Influences of lead exposure on its accumulation in organs, meat, eggs and bone during laying period of hens. *Poultry Science*, 100(8), 101249.
- [47] Wang S.J., Zhang J.W., Ma J., Yang H., Shao X.Q., Su M., Zhou Z.L., **Li Z.** (2021) Applying Pb²⁺ to probe the dissolution of carbonated hydroxylapatite by enterobacter sp.: a new insight into the bioerosion of tooth mineral. *Journal of Biomedical Materials Research Part B: Applied Biomaterials*, 109(8), 1230-1238.

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- [46] Zhang J.W., Tang L.Y., Geng Y.Y., Ma J., Yang H., Huo Z.L., **Li Z.*** (2021) Microbial regulation of dissolution, adsorption and precipitation of phosphates influenced by various carbon sources. *Chemical Geology*, 560(19): 120021.
- [45] Su M., Han F.Y., Wang M.X., Ma J.X., Wang X.W., Wang Z.J., Hu S.J., **Li Z.*** (2021) Clay-assisted protection of *Enterobacter* sp. from Pb (II) stress. *Ecotoxicology and Environmental Safety*, 208: 111704.
- [44] Zhang L., Gadd G.M., **Li Z.*** (2021). Microbial biomodification of clay minerals. Chapter in 2021 *Advances in Applied Microbiology*, 111-128.
- [43] Wang M.X., Ma J.X., Wang X.W., Wang Z.J., Tang L.Y., Chen H.M.*, **Li Z.*** (2020) Detoxification of Cu(II) by the red yeast *Rhodotorula mucilaginosa*: from extracellular to intracellular. *Applied Microbiology and Biotechnology*, 104: 10181-10190.
- [42] Tian D., Su M., Zou X., Zhang L.L., Geng Y.Y., Qiu J.J., Wang S.M., Gao H.J.*, **Li Z.*** (2020) Influences of phosphate addition on fungal weathering of carbonate in the red soil from karst region. *Science of The Total Environment*, 755: 142570.
- [41] Chen H.M., Tang L.Y., Wang Z.J., Su M., Tian D., Zhang L., **Li Z.*** (2020) Evaluating the protection of bacteria from extreme Cd (II) stress by P-enriched biochar, *Environmental Pollution*. 263: 114483.
- [40] Jiang Z.Q., Wang T., Sun Y.L., Nong Y., Tang L.Y., Gu T.T.*, Wang S.M., **Li Z.*** (2020) Application of Pb(II) to probe the physiological responses of fungal intracellular vesicles, *Ecotoxicology and Environmental Safety*. 194: 110441.
- [39] Jiang Z.Q.[#], Jiang L.[#], Zhang L., Su M., Tian D., Wang T., Sun Y.L., Nong Y., Hu S.J., Wang S.M., **Li Z.*** (2020) Contrasting the Pb (II) and Cd (II) tolerance of *Enterobacter* sp. via its cellular stress responses, *Environmental Microbiology* 22(4): 1507-1516.
- [38] Wu Y.L.[#], Shao X.Q.[#], Jiao H., Song X.W., He K., **Li Z.*** (2020) Tracking the fungus-assisted biocorrosion of lead metal by RISE technique, *J. Raman Spectroscopy*, 51: 508-513 (**Featured Cover**).
- [37] Okolie C., Chen H.M., Zhao Y.X., Tian D., Zhang L., Su M., Jiang Z.Q., **Li Z.***, Li H.X. (2020) Cadmium immobilization in aqueous solution by *Aspergillus niger* and geological fluorapatite, *Environ. Sci. Pollut. Res.* 27: 7647-7656.
- [36] Tang L.Y., Zhang L., Yue M., Tian D., Su M., **Li Z.***(2019) New insights into the ultrastructure of bioapatite after partial dissolution: based on whale rostrum, the densest bone, *Microscopy & Microanalysis*, 25: 1323-1330.

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- [35] Chen H.M., Zhang J.W., Tang L.Y., Su M., Tian D., Zhang L., **Li Z.***, Hu S.J. (2019) Enhanced Pb immobilization via the combination of biochar and phosphate solubilizing bacteria, *Environ. Int.*, 127: 395-401.
- [34] Li C.K., Li Q.S., Wang Z.P., Ji G.N., Zhao H., Gao F., Su M., Jiao J.G.*, **Li Z.***, Li H.X. (2019) Environmental fungi and bacteria facilitate lecithin decomposition and the transformation of phosphorus to apatite, *Sci Rep.*, 9: 15291.
- [33] Tang L.Y., Shen Z.T., Duan X.F., Wang Z.J., Wu Y.Y., Shao X.Q., Song X.W., Hu S.J., **Li Z.*** (2019) Evaluating the potential of charred bone as P hotspot assisted by phosphate-solubilizing bacteria, *Science of the Total Environ.*, 696: 133965.
- [32] Zhang L., Song X.W., Shao X.Q., Wu Y.L., Zhang X.Y., Wang S.M., Pan J.J., Hu S.J., **Li Z.*** (2019) Lead immobilization assisted by fungal decomposition of organophosphate under various pH values, *Sci. Rep.*, 9: 13353.
- [31] Wang S.J., Hu Y.X., Wu Y.L., Liu Y.W., Liu G.P., Yan Z.J., Li Q., Zhou Z.L.*, **Li Z.*** (2019) Influences of bioapatite mineral and fibril structure on the mechanical properties of chicken bone during the laying period, *Poultry Sci.*, 98: 6393-6399.
- [30] Su M., Han F.Y., Wu Y.L., Yan Z.P., Lv Z.S., Tian D., Wang S.M., Hu S.J., Shen Z.T., **Li Z.*** (2019) Effects of phosphate-solubilizing bacteria on phosphorous release and sorption on montmorillonite, *Applied Clay Sci.*, 181: 105227
- [29] Zhang L., Hu Y.X., Han F.Y., Wu Y.L., Tian D., Su M., Wang S.M., **Li Z.***, Hu S.J. (2019) Influences of multiple clay minerals on the phosphorus transport driven by *Aspergillus niger*, *Applied Clay Sci.*, 177: 12-18.
- [28] Li J.J., Jiang Z.Q., Chen S.S., Wang T., Jiang L., Wang M.X., Wang S.M.*, **Li Z.*** (2019) Biochemical changes of polysaccharides and proteins within EPS under Pb (II) stress in *Rhodotorula mucilaginosa*, *Ecotoxicol. Environ. Safety*, 174: 484-490.
- [27] Li Q., Xia J.F., Wang S.J., Zhou Z.L.*, **Li Z.***. (2019) Letrozole induced changes in bone mineral properties and mechanical functions of laying hens, *Poultry Sci.*, 98: 2562-2569.
- [26] Guo C.M., Tian W.T., Wang Z.J., Han F.Y., Su M., Wu Y.L., **Li Z.***, Hu S.J. (2019) Reduction of Pb availability during surficial leaching in different types of soils with addition of apatite and oxalic acid, *J. Soils Sediment.* 19(2): 741-749.
- [25] Tian D., Jiang Z.Q., Jiang L., Su M., Feng Z.Y., Zhang L., Wang S.M.*, **Li Z.***, Hu S.J. (2019) A new insight into lead (II) tolerance of environmental fungi based on a study of *Aspergillus niger* and *Penicillium oxalicum*, *Environ. Microbiol.*, 21(1): 471-479
(Wiley Highly Cited).

- [24] Wang S.J., Liu, M.H., Tian D., Su M., Li Q., **Li Z.***, Zhou Z.L.* (2019) Identifying the initiation and aging during laying period of hens by Raman analysis on their beaks, *J. Poultry Sci.*, 56: 159-165.
- [23] Tian D., Lai Z.Y., Zou X., Guo C.M., Yang L.Y., Su M., **Li Z.***, Hu S.J. (2018) A contrast of lead immobilization via bioapatite under elevated CO₂ between acidic and alkaline soils, *Soil Use Managem.*, 34: 542-544.
- [22] Zhang X.Y., Zhang L., Zou X., Han F.Y., Yan Z.P., **Li Z.***, Hu S.J.* (2018) Semi-quantitative analysis of microbial production of oxalic acid by montmorillonite sorption and ATR-IR, *Appl. Clay Sci.*, 162: 518-523.
- [21] **Li Z.***, Su M., Duan X.F., Tian D., Yang M.Y., Guo J.Y., Wang S.M.*, Hu S.J.* (2018), Induced biotransformation of lead (II) by *Enterobacter* sp. in SO₄-PO₄-Cl solution, *J. Hazard. Mater.*, 357: 491-497.
- [20] Tian D., Wang W.C., Su M., Zheng J.Y., Wu Y.Y., Wang S.M.*, **Li Z.***, Hu S.J. (2018) Remediation of lead-contaminated water by geological fluorapatite and fungus *Penicillium oxalicum*, *Environ. Sci. Pollut. Res.*, 25: 21118-21126.
- [19] Tang L.Y., Duan X.F., Kong F.J., Zhang F., Zheng Y.F., **Li Z.***, Mei Y.*, Zhao Y.W.*, Hu S.J. (2018) Influences of climate change on area variation of Qinghai Lake on Qinghai-Tibetan Plateau since 1980s, *Sci. Rep.*, 7331.
- [18] Shen Z.T., **Li Z.***, Alessi D.S. (2018) Stabilization-based soil remediation should consider longterm challenges, *Front. Environ. Sci. Eng.*, 12(2): 16.
- [17] **Li Z.**, Deng Z.L., Chen S.S., Yang H., Zheng Y.F., Dai L.T., Zhang F., Wang S.M.*, Hu S.J.* (2018) Contrasting physical and biochemical properties of orchard soils suppressive and conducive to Fusarium wilt of banana, *Soil Use Managem.*, 34: 154-162.
- [16] Shen Z.T., Tian D., Zhang X.Y., Tang L.Y., Su M., Zhang L., **Li Z***, Hu S.J.*, Hou D.Y. (2018) Mechanisms of biochar assisted immobilization of Pb²⁺ by bioapatite in aqueous solution, *Chemosphere*, 190: 260-266.
- [15] **Li Z.**, Su M., Tian D., Tang L.Y., Zhang L., Zheng Y.F., Hu S.J.* (2017) Effects of elevated atmospheric CO₂ on dissolution of geological fluorapatite in water and soil. *Sci. Total Environ.*, 599-600: 1382-1397.
- [14] Li Q., Lu L., Xie S.D., Zhang P.H., Wang S.J., Zhang X.Y., Zhou Z.L.*, **Li Z***. (2017) Mineralogical changes of bioapatite in femoral bones of mice during pregnancy, *Spectros. Lett.*, 50(6), 336-341.
- [13] **Li Z.***, Tang L.Y., Zheng Y.F., Tian D., Su M., Zhang F., Ma S.J., Hu S.J.* (2017) Characterizing the mechanisms of lead immobilization via bioapatite and various clay minerals, *ACS Earth Space Chem.*, 1, 152-157.

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- [12] Wang S.J., Zhang P.H., Kong X.F., Xie S.D., Li Q., **Li Z***, Zhou Z.L.* (2017) Delicate changes of bioapatite mineral in pig femur with addition of dietary xylooligosaccharide: Evidences from Raman spectroscopy and ICP, *Animal Sci. J.*, 88(11), 1820-1826.
- [11] Chen W.K., Wang Q.Z., Meng S.T., Yang P., Jiang L., Zou X., **Li Z***, Hu S.J.* (2017) Temperature-related changes of Ca and P release in synthesized hydroxylapatite, geological fluorapatite, and bone bioapatite, *Chem. Geol.*, 451:183-188.
- [10] Zheng W.J., Yang H., Xuan G.H., Dai L.T., Hu Y.X., Hu S.J., Zhong S.K., **Li Z***, Gao M.Y., Wang S.M., Feng Y*. (2017) Longitudinal study of the effects of environmental pH on the mechanical properties of *Aspergillus niger*. *ACS Biomater. Sci. Engineer.*, 3: 2974-2979.
- [9] **Li Z.**, Wang F.W., Bai T.S., et al. (2016) Lead immobilization by geological fluorapatite and fungus *Aspergillus niger*. *J Hazard. Mater.*, 320: 386-392.
- [8] **Li Z.**, Bai T.S., Dai L.T., et al. (2016) A study of organic acid production in contrasts between two phosphate solubilizing fungi: *Penicillium oxalicum* and *Aspergillus niger*. *Sci. Rep.*, 6: 25313.
- [7] **Li Z.**, Li Q., Wang S.J., et al. (2016) Rapid increase of carbonate in cortical bones of hens during laying period. *Poultry Sci.*, 95: 2889-2894.
- [6] **Li Z.**, Al-Jawad M., Siddiqui S., Pasteris J.D.* (2015) A mineralogical study in contrasts: highly mineralized whale rostrum and human enamel. *Sci. Rep.*, 5: 16511.
- [5] **Li Z.***, Wu S.P., and Ye C.L. (2015) Temperature-related changes of bioapatite based on hypermineralized dolphin's bulla. *J. Raman Spectros.*, 46: 964-968.
- [4] **Li Z.** and Pasteris J. D.* (2014) Tracing the pathway of compositional changes in bone mineral with age: Preliminary study of bioapatite aging in hypermineralized dolphin's bulla. *BBA-Gen. Sub.*, 1840: 2331-2339.
- [3] **Li Z.** and Pasteris J. D.* (2014) Chemistry of bone mineral, based on the hypermineralized rostrum of the beaked whale *Mesoplodon densirostris*. *Am. Miner.*, 99: 645-653.
- [2] **Li Z.**, Pasteris J. D.*, et al. (2013) Hypermineralized whale rostrum as the exemplar for bone mineral. *Connect Tissue Res.*, 54(3):167-175.
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