WANG Fugang, GENG Xinxin, GAO Zhenkai, JING Jing and CAO Yuqing, 2013. Quantitative Groundwater Circulation Pattern Construction Based on Isotopic Hydrogeological Theory and Method: A Case Study for Lingwu Area in Northwest China. *Acta Geologica Sinica* (English Edition), 87(supp.): 652-653.

Quantitative Groundwater Circulation Pattern Construction Based on Isotopic Hydrogeological Theory and Method: A Case Study for Lingwu Area in Northwest China

WANG Fugang*, GENG Xinxin, GAO Zhenkai, JING Jing and CAO Yuqing

Key Lab of Groundwater Resources and Environment, Ministry of Education, Jilin University, Changchun 130021, China

Lingwu Daquan area located in Ningxia Autonomous Region in northwest China. It is an important water source area of Ningdong Energy Base, and also a typical area of groundwater severely affected by irrigation and groundwater development in the northwest China arid area. To build the region one of the scientific and objective quantitative groundwater circulation pattern, not only has practical value for Ningdong Energy Base of groundwater utilization，but also has scientific significance to development and utilization of groundwater resources in arid areas.

Through field investigation, soil and water sample collection, test, to obtain first-hand data in the study area. Based on isotope hydrogeological theory and methods, simultaneously considering of the multiple conditions and factors related to the groundwater circulation mode: the basic condition(geological setting)of controlling groundwater circulation, the necessary condition (hydrodynamic condition)of groundwater circulation occurrence, the water chemistry and isotopic tracing effect, etc., comprehensively and systematically analyze the groundwater's hydraulic relations, among low hills, terrace in the east of Daquan area and the Alluvial-diluvial sloping plain, between phreatic water and confined water, between the north and south groundwater in Alluvial-lacustrine plain area, between Yellow River and groundwater in Alluvial-lacustrine plain area. Based on the isotopic hydrogeological theory and method, groundwater circulation speed and renewability are calculated by using the isotope data of groundwater samples. On the basis of above research, a quantitative groundwater circulation pattern of the study area is constructed. Research provides a scientific reference for the groundwater development and utilization to Ningdong Energy Base and arid (or semiarid) area in northwest China.

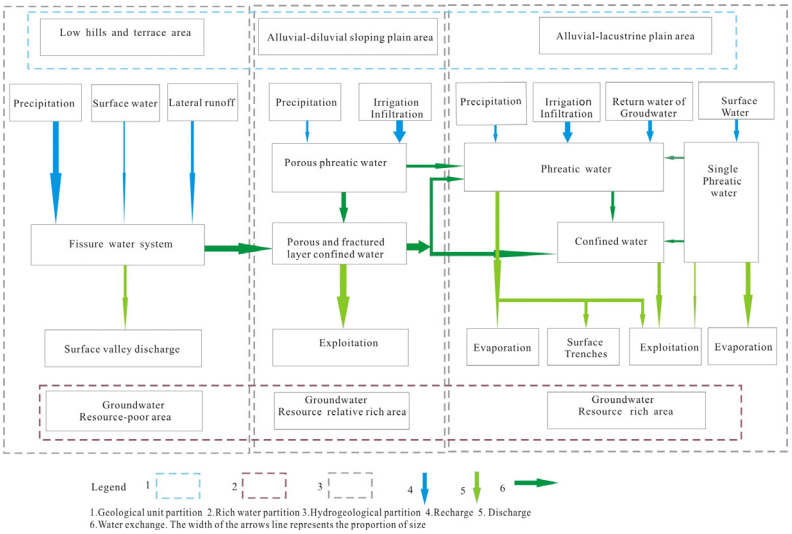

Fig1. Groundwater system cycle mode structure of the study area

Acknowledgements

This work was supported by the National Natural Science Foundation of China (41172205) ,and the Project Sponsored by the Scientific Research Foundation for Returned Overseas Chinese Scholars, State Education Ministry.and the opening funds of Key Lab of Groundwater Resources and Environment, Ministry of Education, Jilin University

Key words: Lingwu; isotopic hydrogeological theory; Groundwater circulation pattern; Isotope tracer; Groundwater circulation speed; Groundwater renewability

* Corresponding author. E-mail: wangfugang@jlu.edu.cn

References

Ba, Q.and Xu, Y.J., 2010. Input function and simulated distributions of tritium in the North Pacific. *China: Earth Sci*.53 (3), 441 – 453.

Celle-Jeanton, H., Gourcy, L.and Aggarwal, P. K.J., 2001. Reconstruction of tritium time series in precipitation. International Conference: Study of Environmental Change Using Isotope Techniques, 430– 432.

Clark, I.D.and Fritz, P.J., 1997. Environmental Isotopes in Hydrogeology. Lewis Press, New York, 328 pp.

Doney, S.C., Glover, D.M.and Jenkins, W. J., 1992. A model function of the global bomb tritium distribution in precipitation, 1960– 1986. *Geophys.Res.-Oceans* 97(C4), 5481 –5492.

Edmunds, W. M., Fellman, E., Goni, I. B. and Prudhomme, C.J., 2002. Spatial and temporal distribution of Groundwater recharge in northern Nigeria.*Hydrogeol*.10, 205– 215.

Flint, A. L., Flint, L. E., Kwicklis, E. M., Fabryka-Martin, J. T. and Bodvarsson, G. S.J. ,2002. Estimating recharge at YuccaMountain, Nevada, USA: comparison methods. *Hydrogeol*. 10,180– 204.

Warren W.W.and Ward E.S.J., 1994.Chemical and Isotopic Methods For Quantifying Ground-Water Recharge in a Regional Semiarid Environment.*GroundWater*.33 (3): 458-468.

Seifu K., Yves T., Tamiru A.L., et al.J.,2005. Ground water recharge, circulation and geochemical evolution in the source region of the Blue Nile River, Ethiopia.*Applied Geochemistry*.20 (9):1658-1676.

Chen Zhu.J., 2000. Estimate of recharge from radiocarbon dating of groundwater and numerical and transport modeling. *Water Resources Research*.36 (9):2607-2620.

Davisson M. L. et al.J., 1999. Isotope hydrology of Southern Nevada groundwater: Stable isotopes and radiocarbon. *Water Resources Research*.35 (l), 279-294

Viville D., Ladouche B.and Bariac T.J., 2006. Isotope hydrological study of mean transit time in the granitic Strengbach catchment (Vosges massif, France): application of the Flow PC model with modified input function. *Hydrological processes*.20:1737-1751.

Gibson, J. J., Edwards, T. W. D., Birks, S. J., St. Amour, N. A., Buhay, W. M., McEachern, P., Wolfe, B. B. and Peters, D.L. J. ,2005. Progress in isotope tracer hydrology in Canada . *Hydrol Process* . 19, 303– 327.

Le Gal La Salle, C., Marlin, C., Leduc, C., Taupin, J. D., Massault, M. and Favreau, G..J, 2001. Renewal rate estimation of groundwater based on radioactive traces (^{3}H, ^{14}C) in an unconfined aquifer in a semi-arid area, Iullemeden Basin, Niger. *Hydrol*.254, 145–156.

Leduc C.et al.J.,1996.Groundwater recharge in Niamey, Niger, estimated from tritium measurements .Comptes *Rendus de l'Academie des Science*.3(7):599-605.

Dongyan, GAO.D. 2012. Study of groundwater circulation mechanism in Ling Wu Da Quan area. Jilin University (in Chinese with English abstract)

Cun-fu, WANG Pei-yi, ZHOU Lian.J., 1997.Environmental meaning of groundwater isotopic components of hydrogen, oxygen, carbon, and chlorine in Hebei Plain. *Earth Science Frontiers*.4 (1- 2):267- 274.

Clark J F, Stute M, Schlosser P.J.,1997.A tracer study of the Floridian aquifer in southeastern Georgia: Implications for groundwater flow and paleoclimate.*Water Resources Research*.33 (2):281- 289.

ZHANG Guang-hui, CHEN Zong-yu, FEI Yu-hong.J., 2000. Relationship between the formation of groundwater and the evolution of regionalhydrologic cycle in North China Plain. *Advances in Water Science*.11 (4):415- 420. (In Chinese with English abstract)

Ofterdinger U S, Balderer W, Loew S, et al.J., 2004. Environmental isotopes as indicators for ground water recharge to fractured granite. *Ground Water*.42 (6):868- 879.

Weyhenmeyer C E, Burns S J, Waber H N.J., 2002.Isotope study of moisture sources, recharge areas, and groundwater flow paths within the eastern Batinah coastal plain, Sultanate of Oman. *Water Resources Research*.38 (10):1184- 1206.

GENG Xin-xin, WANG Fu-gang, GAO Zhen-kai, GAO-dongyan., 2013. Simulation of groundwater hydrochemical evolution characteristics in Yellow River irrigation area of Ling-Wu county. *Chinese J .Water Saving Irrigation* .2:29-33 (in Chinese with English abstract)

YANG Zhi,LI Hong-xia,WU Xue-hua,LIU Hui-min.,2007. Estimating of the upstate speed of groundwater in YINCHUN plain by using the radioactive element-^{3}H.*Chinese J .Ninxia Engineering Technology.* 6(1):84-87(in Chinese with English abstract)

YU Yan-qing,YU Qiu-sheng,XUE Zhong-qi,YIN Bing-xi.,2005. Application of isotopic techniques identified groundwater recharge patterns in Yinchuan plain. *Chinese J .Ninxia Engineering Technology.* 4(3):208-202(in Chinese with English abstract)

XUE Zhong-qi,YU Qiu-sheng,YU Yan-qing,YIN Bing-xi,YU Jian-hua.,2006.Analysis of the characteristic of groundwater isotopes in Yinchuan plain. *Chinese J, Journal of Hefei university technology*.29 (5):591-592(in Chinese with English abstract)

JIA Xiu-mei,SUN Ji-chao,CHEN Xi,HUANG Guan-xing,WU Xue-hua,YU Dong-mei.,2009.Distribution characteristics of hydrogen and oxygen compositions and ^{14}C ages in confined water of Yinchuan plain. *Chinese J.GEOSICENCE*.23 (1):15-21(in Chinese with English abstract)

SU Xiao-si, LIN Xue-yu., 2004.Cycle Pattern and Renewability Evaluation of Groundwater in Yinchuan Basin: Isotopic Evidences. *Chinese J .Resources science*.26 (2):29-35(in Chinese with English abstract).

SU Xiao-si, LIN Xue-yu., 2003.Application of isotope techniques in the research of the groundwater circulation model and renewability in Baotou plain. *Chinese J.Journal of Jilin University (Earth Sciences edition)* (in Chinese with English abstract).J.4: 501~508.

HUANG Tian-ming, PANG Zhong-he., 2007. Groundwater recharge in Badain Jaran desert and GurinaiOasis based on Environmental Tracers. *Chinese J.GEOSCIENCE*.21 (4):624-629(in Chinese with English abstract)

SUN Ya-qiao, QIAN Hui, ZHANG Li, ZHANG Qin., 2006.The groundwater chemistry characteristics of Yinchuan region. *Chinese J. Agricultural Research in the Arid Areas*.24 (3):185-189(in Chinese with English abstract)

PANG Zhonghe. 2001. Isotope and chemical geothermometry and its application. *Science in* china(English edition). vol44:16-20