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Fuzzy logic modeling for integrating the thematic layers derived from ASTER and WorldView-3 remote sensing satellite imagery: A Mineral exploration technique

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Abstract

In this study, **fuzzy logic modeling** was applied to integrate the thematic layers produced by Principal Component analysis (**PCA**) technique for generating **Pb-Zn mineral prospectivity maps** using ASTER and WorldView-3 satellite remote sensing data. A spatial subset zone of the Central Iranian Terrane (CIT), Iran was selected in this study. For the processing of the satellite remote sensing datasets and producing alteration thematic layers, PCA techniques was implemented. The **PCA4**, **PCA5** and **PCA8** were selected as the most rational alteration thematic layers of **ASTER** for generating prospectivity map. The fuzzy gamma operator was used to fuse the selected alteration thematic layers. The **PCA3**, **PCA4** and **PCA6** thematic layers (most rational alteration thematic layers) of **WV-3** were fused using fuzzy AND operator. Field reconnaissance, X-ray diffraction (**XRD**) analysis and Analytical spectral devices (**ASD**) spectroscopy were carried out to verify the occurrence of alteration zones and high prospective locations of Pb-Zn mineralization in the study area. Subsequently, mineral prospectivity maps of the study area were generated showing high potential zones of Pb-Zn mineralization.

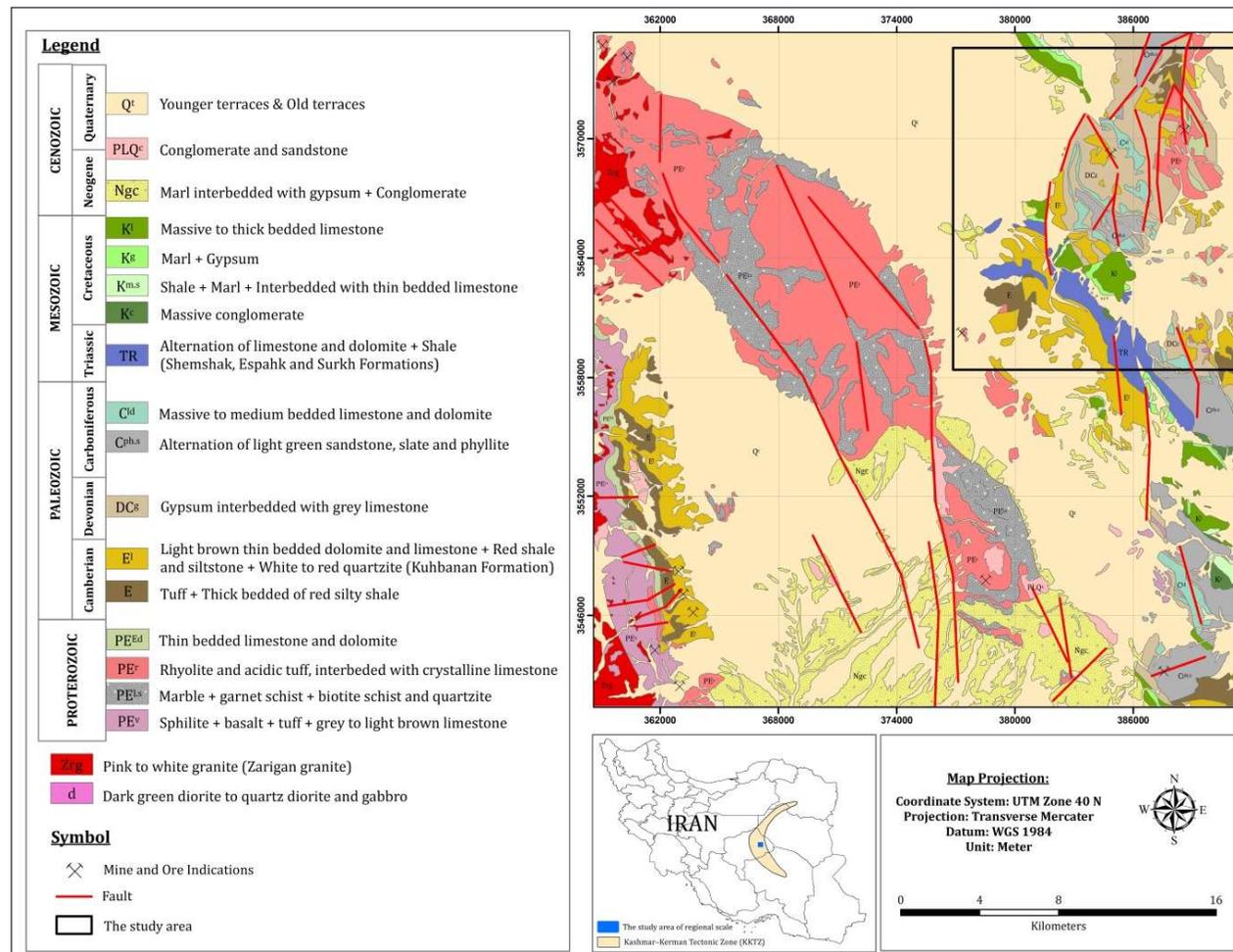
Keywords: ASTER; WorldView-3; fuzzy logic modeling; mineral exploration

Introduction

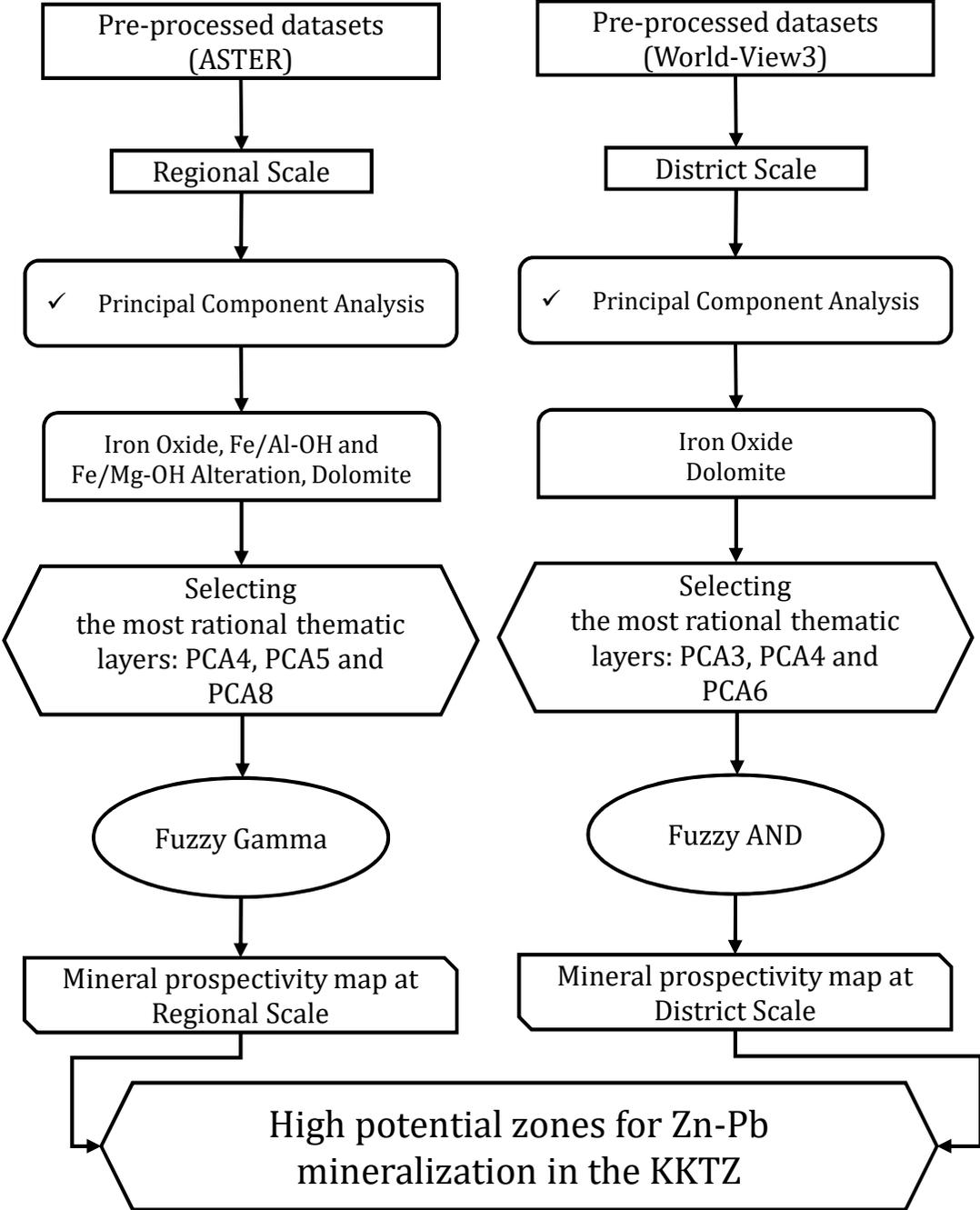
- (i) to map **hydrothermal alteration** minerals and lithological units by implementing Principal Component Analysis (**PCA**) techniques to **ASTER** and **WV-3** datasets.
- (ii) to generate **mineral prospectivity maps** by fusing the most rational thematic layers using **fuzzy logic** modeling.
- (iii) to verify the remote sensing results by **field reconnaissance** and **laboratory analysis**.

Geologic setting of the study area

The **sediment-hosted Pb-Zn mineralization** in the study area is formed during synchronous faulting activities with sedimentation, detrital sedimentation associated with faulting activities, replacement of rhyolitic volcanic rocks and formation of rift sediments and subsidence.

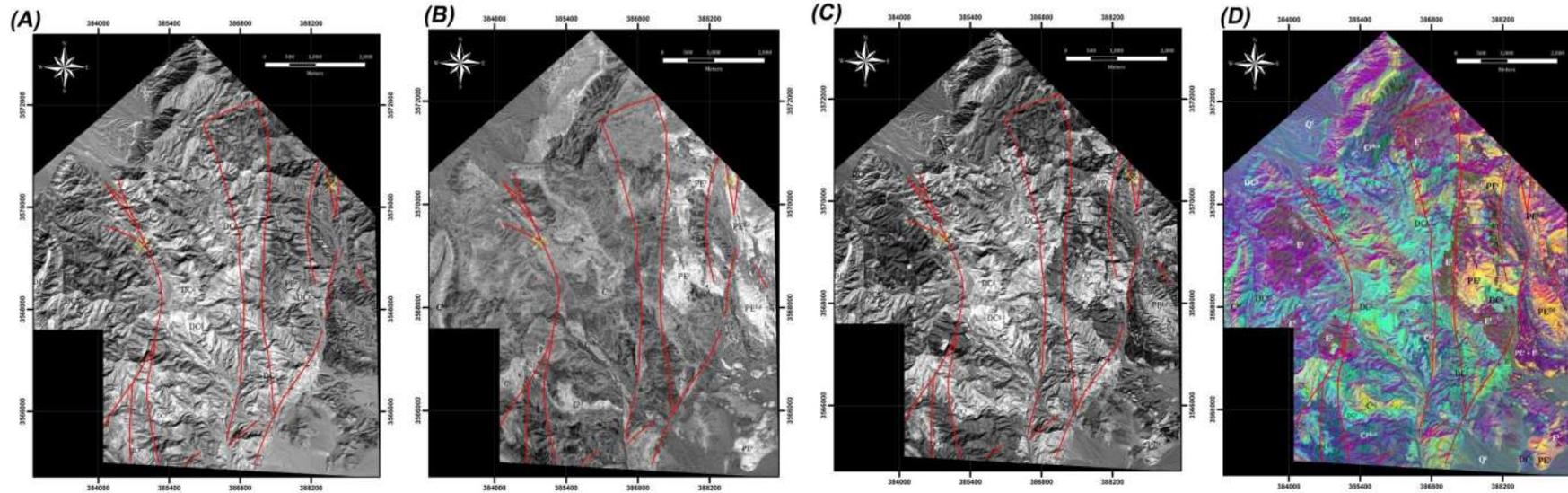


Materials and methods

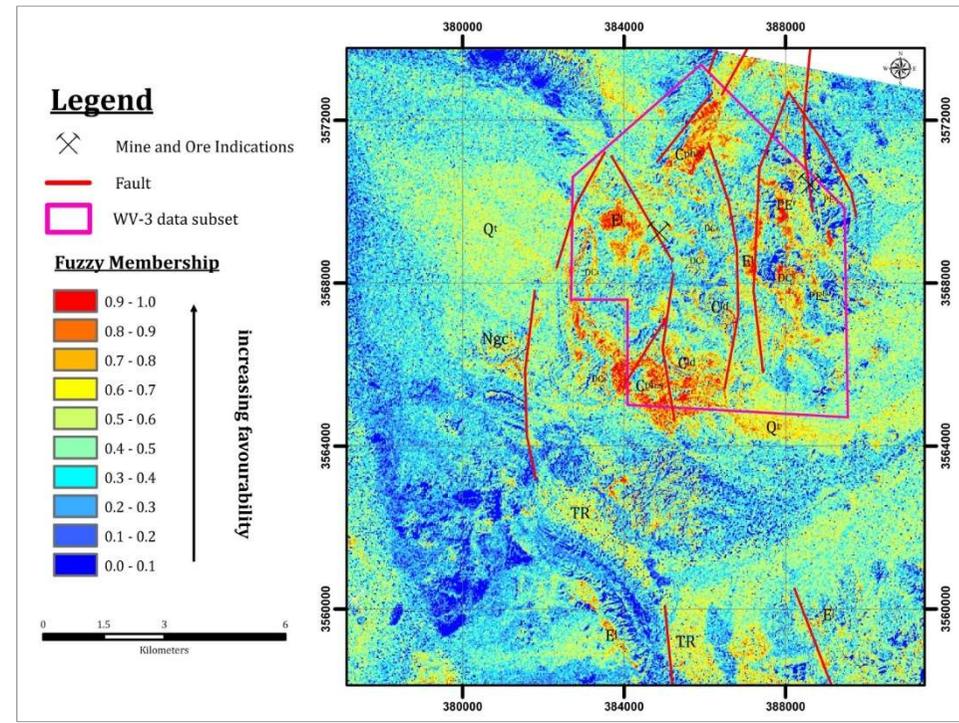
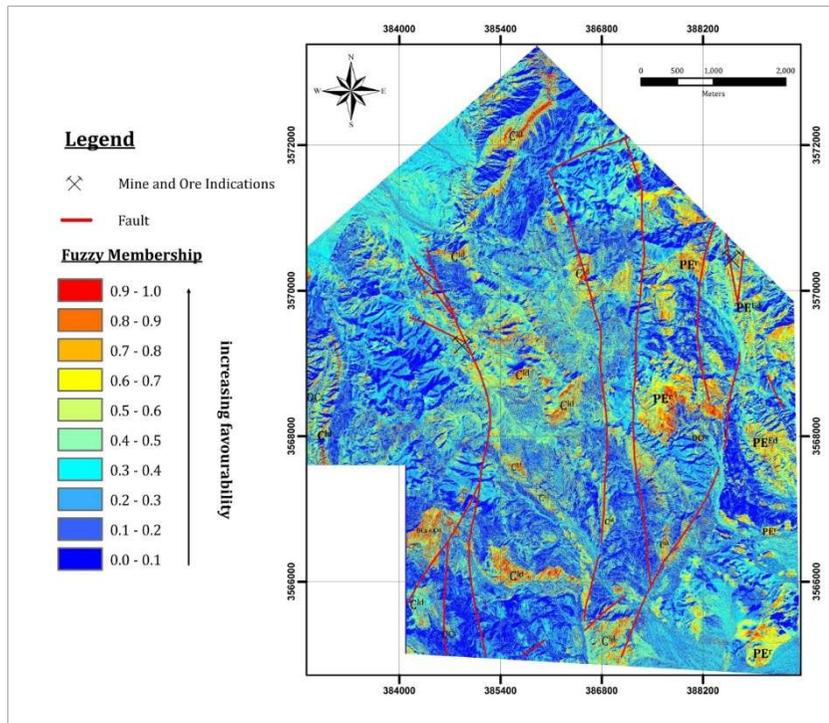


Results

Eigenvector	Band 1	Band 2	Band 3	Band 4	Band 5	Band 6	Band 7	Band 8
PCA 1	-0.314986	-0.330951	-0.348156	-0.359256	-0.364601	-0.367182	-0.369097	-0.370119
PCA 2	0.655926	0.454510	0.183457	-0.046042	-0.154854	-0.251952	-0.320189	-0.370709
PCA 3	-0.331273	-0.598506	0.354295	-0.129646	0.661001	-0.220796	0.341420	0.108973
PCA 4	-0.244961	0.345377	0.145561	0.631659	0.012267	0.368220	-0.509311	-0.142316
PCA 5	-0.384633	0.279151	0.433976	-0.092808	0.081588	-0.370014	-0.142544	0.187618
PCA 6	0.236442	-0.427799	-0.515988	-0.065670	0.646312	0.248715	0.043257	0.095274
PCA 7	0.257771	-0.301701	-0.070317	-0.389055	0.471694	0.225588	-0.427691	0.035215
PCA 8	0.174655	-0.560947	0.307690	-0.163685	-0.332755	0.108819	0.068151	-0.001993



Results



Conclusions

The application of remote sensing satellite imagery and fusing the most rational alteration thematic layers using the fuzzy-logic model is capable of providing a cost-efficient exploration approach for prospecting sediment-hosted Pb-Zn mineralization around the world.

Thank You

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