KANSAS GEOLOGICAL SURVEY
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A Preliminary Interpretation of Cominco American Detailed Aeromagnetic Data from Riley and Marshall Counties, Kansas

by

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SUMMARY

Cominco American has provided the Kansas Geological Survey with two detailed, aeromagnetic data sets. The data sets were flown as part of their Kansas diamond exploration program for the purpose of locating magnetic kimberlite bodies in Riley (1981) and Marshall (1983) Counties in northeastern Kansas (Mansker, Richards and Cole, 1987 and Cominco, 1993). As part of the agreement in providing the data, Cominco requires the disclaimer stating that all interpretive work published by the Kansas Geological Survey is a product of the Kansas Geological Survey and that Cominco has had no involvement in developing these interpretations. The data sets were provided to the Kansas Geological Survey in contour form and as re-digitized files from these contour maps. Images of the digitized data (Figure 1 and Figure 2) are included in this Open-file report. The lack of original flight line digital data limits the utility of the data sets for both kimberlite exploration and regional interpretation of bedrock geology. The digital flight line data for the Riley County survey was later acquired but was not used in this report.

A preliminary, two part, interpretation of the Cominco aeromagnetic data was carried out by the authors at the Kansas Geological Survey and is the subject of this Open-file report.

The first part is a regional interpretation of the Precambrian bedrock geology. This work has identified four different magnetic terrains and a number of regional bedrock structures and provides insight into the covered Precambrian bedrock lithology in Riley and Marshall Counties. In addition three structurally controlled alkalic intrusives are interpreted to occur in Marshall County.

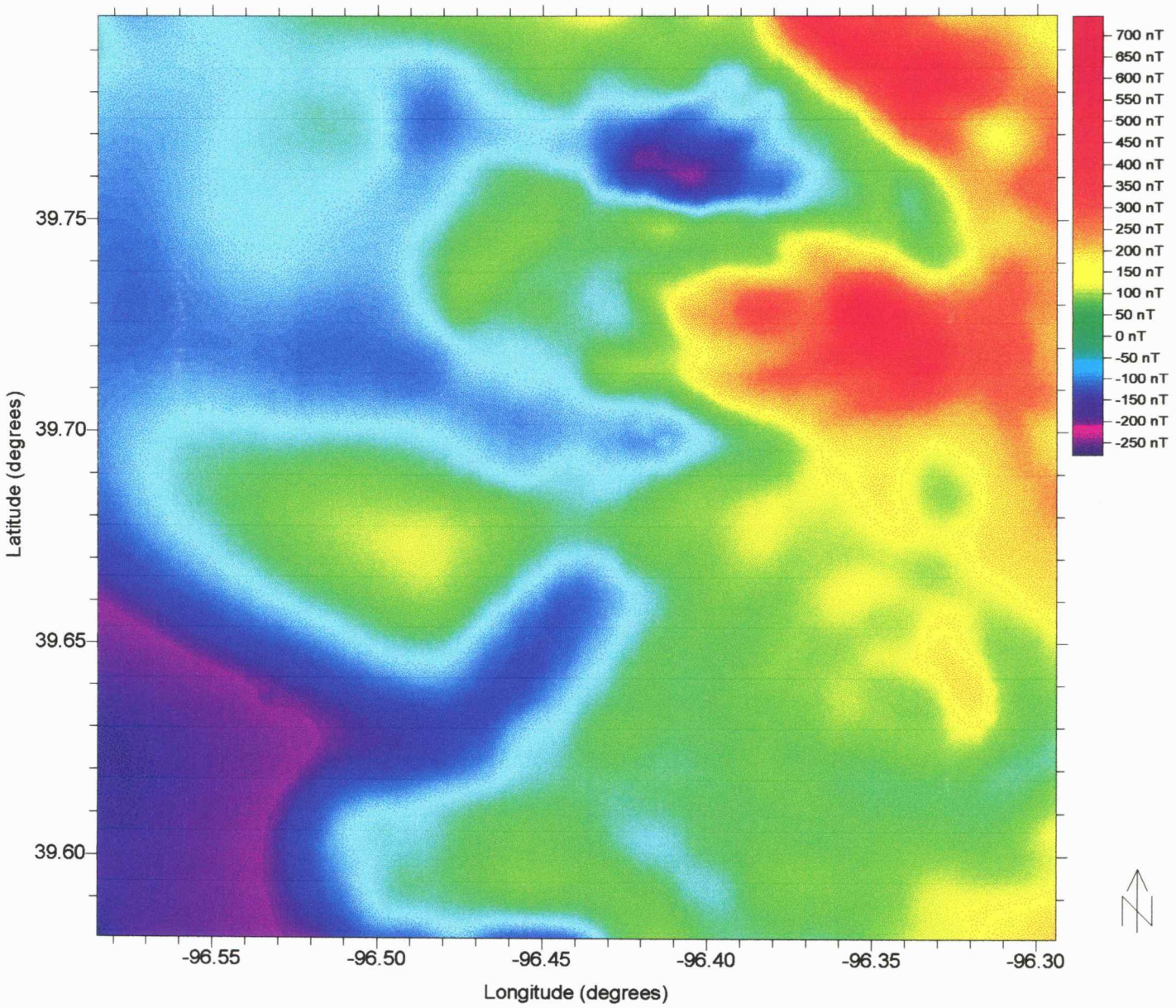
The second part of this interpretation has identified a number of kimberlite exploration targets. They are short wavelength, shallow source, magnetic anomalies. A total of 23 short wavelength anomalies have been identified in Riley County and 41 in Marshall County. Of these, ten are known kimberlite intrusive bodies in Riley County. Three additional anomalies were suspected kimberlite intrusive bodies and have since been confirmed by Kansas Geological Survey core drilling. The remaining anomalies are either kimberlite exploration targets or cultural features such as buildings and bridges (Appendix 1 and 2).

Preliminary interpretation maps are included in this Open-file report (see Plates 1 and 2).

AEROMAGNETIC DATA SETS

Cominco American, as part of their Kansas Diamond Exploration Program, flew two detailed aeromagnetic surveys in Riley and Marshall Counties in the early 1980's. The surveys were flown to detect magnetic kimberlite intrusives.

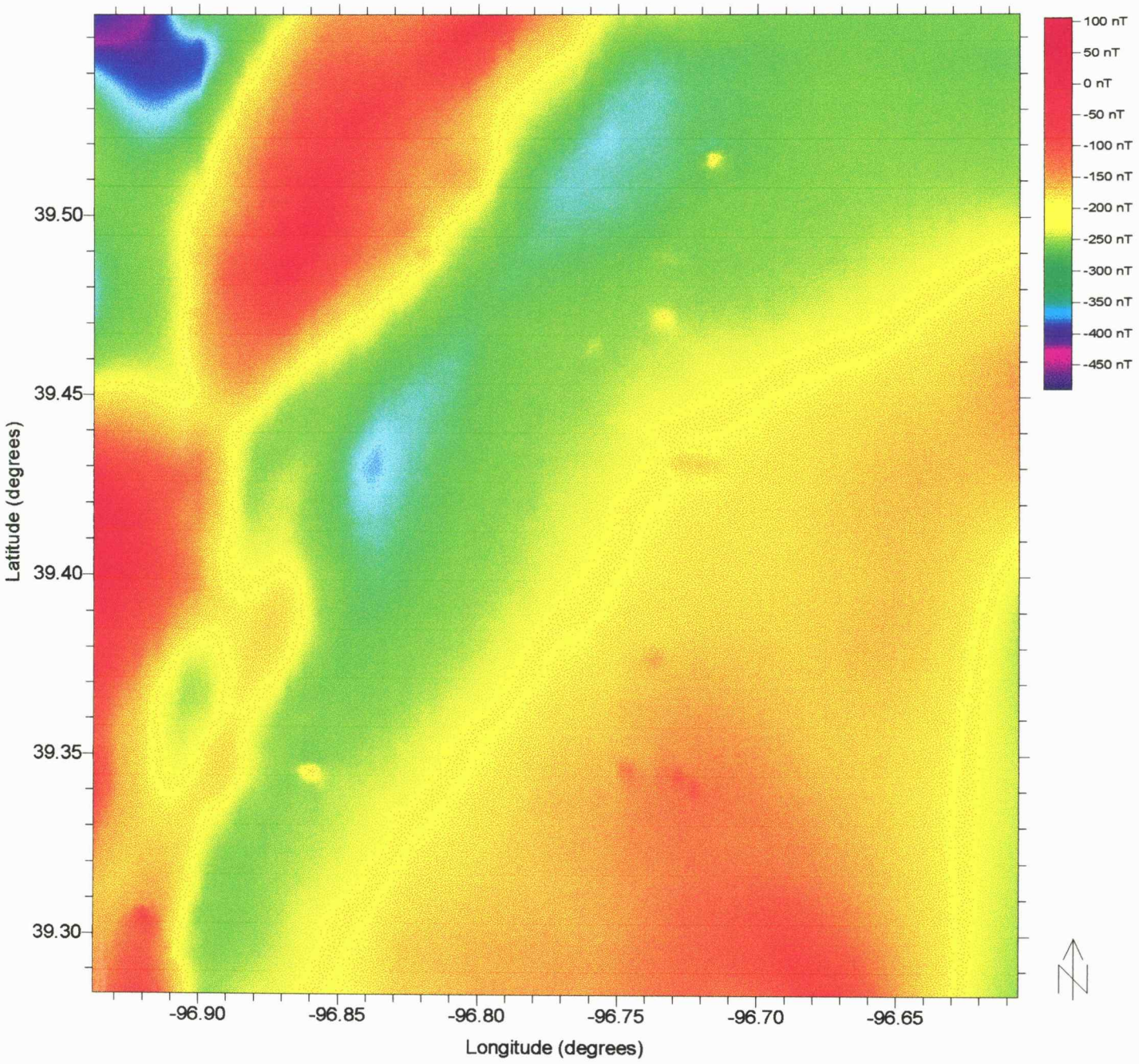
Marshall County, Kansas Aeromagnetic Survey 1983
Total Magnetic Intensity
(Source: Cominco American Inc.)



4.3 Kms
0.00 deg 0.05 deg

Figure 1

Riley County, Kansas Aeromagnetic Survey 1981
Total Magnetic Intensity
(Source: Cominco American Inc.)



4.3 Kms

0.00 deg 0.05 deg

Figure 2

Kimberlites are the main mechanism for transporting diamonds from the mantle, where they form, to the earth's surface. The kimberlite bodies have small lateral dimensions ranging from a few meters to a few hundred meters. Because of the small target dimensions the data sets collected by Cominco are detailed, having approximately 1/8th mile (200 meters) line spacing.

1981 Riley County Survey

Cominco's Riley County survey was flown in 1981 by Applied Geophysics of Salt Lake City, Utah. The survey has the following specifications. The line direction is North-South. The line spacing is 750 feet (1/7 mile). The survey is a drape survey and the mean terrain clearance is 500 feet. A geoMetrics, G 803, proton precession magnetometer with a sample rate of .8 seconds and a sensitivity of .5 nT (nanoTesla; 1nT=1 gamma) was used. The data was collected digitally on the aircraft but was presented as hand contoured maps with 10 and 50 nT(gamma) contour intervals. The data set is good quality however the hand contouring of the data restricts it's utility. In particular the high frequency content of the data is lost in the hand contouring process. The larger amplitude kimberlite anomalies are detected but the shapes of the anomalies do not reflect the actual source shapes. Subtle anomalies in areas of steep gradients are not well represented in the data.

1983 Marshall County Survey

Cominco's Marshall County survey was flown by Airmag Surveys of Philadelphia Pennsylvania in 1983. The data was collected, processed and contoured digitally which results in an improved representation of anomaly amplitude, shape, location and frequency content. The survey has the following specifications. The flight line direction is N-S. The line spacing is variable, 1/8th and 1/4th miles. The flight altitude is 1600 feet barometric, which results in an average terrain clearance of approximately 350 feet with maximum terrain clearance of 500 feet over the major river valleys and minimum terrain clearance of 250 feet over topographically high areas. The magnetometer used was an Airmag Fluxgate MKIV with a sample period of .25 seconds and a sensitivity of .01 nT(gamma). The main advantages of this data set are higher resolution, closer sample spacing, lower terrain clearance and digital recording with computer contouring.

MAGNETIC TERRAINS, INTRUSIVES AND MAJOR STRUCTURES

The distribution and character of most of the magnetic anomalies on the aeromagnetic contour maps of Marshall and Riley Counties are controlled by magnetite content and depth to the top of Precambrian basement rocks in the vicinity of the Mid-Continent Rift System (MCRS) in Northeastern Kansas. The overlying Paleozoic sediments are essentially non-magnetic and make no

contribution other then controlling the depth to Precambrian basement rocks. A small number of short wave length anomalies, with sources at or near the surface, are due to kimberlites that have been intruded into the Paleozoic sedimentary section during the Cretaceous or to cultural features such as bridges and buildings.

Magnetic Terrains

Four different magnetic terrains have been identified within the detailed aeromagnetic surveys in Riley and Marshall Counties. The individual magnetic terrains are characterized by varying amplitude, wavelength and activity of magnetic anomalies. Anomaly amplitude is a function of both magnetite content of the source rocks and depth to the top of the source rocks. The lithology of the source rocks have an indirect relationship to magnetite content. In general the more mafic the rocks the more magnetite they contain but this relationship may not always hold true. Anomaly wavelength is primarily a function of depth to the top of the magnetic source. The deeper the source is the longer the wavelength. Anomaly activity, which is measured by the number of anomalies per unit area, is a function of lithology, geometry and depth to the top of the source. It distinguishes between isolated anomalies such as intrusives and areas where anomalism is continuous, for example an expanse of volcanic rocks.

Magnetic Terrain 1 (MT1) occurs in the western half of the Marshall County survey block and in the eastern three-quarters of the Riley County survey block. It is characterized by low magnetic activity and flat gradient. Three long wavelength, equidimensional anomalies occur in Magnetic Terrain 1. The smooth, low gradient character is interpreted to be primarily a function of increased depth to magnetic bedrock but may also reflect variations in bedrock lithology. The lower magnetic gradient areas of Magnetic Terrain 1 are interpreted to be less magnetic Precambrian granitic or sedimentary rocks beneath an increased thickness of overlying sediments. The three large amplitude, long wavelength anomalies are interpreted to be mafic or ultramafic intrusive complexes with large depth extent and volume of contained magnetic material (See Plates 1 and 2; MH-1, MH-2 and MH-3).

Magnetic Terrain 2 (MT2) occurs in the northeast quarter of the Marshall County aeromagnetic survey block. Magnetic Terrain 2 is characterized by very active, moderate wavelength, equidimensional magnetic highs and lows. They are interpreted to be due to mafic volcanic rock at shallower (as compared to MT1) depth. Superimposed on these moderate wavelength anomalies is a long wavelength, large amplitude magnetic high interpreted to be a mafic or ultramafic intrusive complex with increased depth extent and volume of contained magnetic material. There is also evidence for two alkalic intrusive complexes (See Plate 1; AI-1 and AI-2) which will be discussed below.

Magnetic Terrain 3 (MT3) occurs in the southeast quarter of the Marshall County aeromagnetic survey block. It is characterized by very active, low to moderate amplitude, moderate wavelength, magnetic highs and lows. This area is interpreted to be underlain by relatively shallow (as compared to MT1) mafic volcanics beneath Paleozoic sediments. It differs from MT2 in that no large depth extent mafic or ultramafic intrusives occur in MT3. There is, however, evidence for an alkalic intrusive (See Plate 1; AI-3), which will be discussed below.

Magnetic Terrain 4 (MT4) occurs in the western quarter of the Riley County survey block. It is characterized by linear, low wavelength, large amplitude, northeast striking, magnetic highs (See Plate 2; MH-7 and MH-8). These highs are interpreted to be due to mafic or ultramafic intrusives with large depth extent and volume of contained magnetic material into less magnetic Precambrian basement, granite or sediments, beneath an increased thickness of Paleozoic sediments.

Intrusives

A number of large amplitude, greater than 250nT, broad, minimum dimension greater than 5 kilometers, magnetic highs are observed in the Marshall and Riley county aeromagnetic data sets. Magnetic highs, MH1 through MH-8 (See Plates 1 and 2) are interpreted to be due to mafic or ultramafic intrusive bodies into volcanic or sedimentary country rocks.

Three circular, zoned magnetic anomalies are identified within Magnetic Terrain 2 and 3 (See Plate 1). They occur along a line striking 009 degrees azimuth and may be controlled by a bedrock structure of that strike direction in the eastern quarter of the Marshall County survey block. They are characterized by a circular magnetic low surrounded by a magnetic high rim. The low may be relative as the intrusive is emplaced into what is interpreted to be more magnetic mafic volcanics. These features are interpreted to be alkalic intrusives, possibly carbonatites. Circular, equi-dimensional, zoned magnetic anomalies are characteristic of alkalic intrusives(Gunn and Dentith, 1977). The Elk Creek carbonatite occurs to the NNE of these anomalies across the border in Nebraska (Hills, Scott, Armbrustmacher and Berendsen, 1991).

Structures

The structural setting, in the vicinity of the Riley and Marshall county survey areas, is dominated by the presence of the Mid-Continent Rift System. The most visible structures in this data set are NNE striking faults running parallel to the Mid-Continent Rift System. They appear to be primarily normal structures, down dropped to the West. Cutting across this NNE trend are transverse faults that

strike EW to NW/SE. No indication of the direction of movement or timing of the cross cutting faults exists in the data (See Plates 1 and 2).

The four magnetic terrains discussed above are separated by major basement structures. Magnetic Terrain I and II are separated by a NE-SW striking structural zone with large normal movement, down to west. Magnetic Terrain III is separated from Magnetic Terrain I by a NE-SW structural zone with large normal movement, down to west. Magnetic Terrain III is separated from Magnetic Terrain II by a major E-W structure. Movement along this structure is not indicated by the aeromagnetic data set. Magnetic Terrain IV is separated from Magnetic Terrain I by a large NE-SW striking structural zone. No evidence exists as to the movement of this structure.

A number of subtle structures also occur in the data sets and are observable for various reasons. For example two such structures exist in Riley County near the Stockdale and Lonetree kimberlites (See Plate 2). A NW/SE striking structure appears to control the dike like emplacement of the Stockdale and Lonetree kimberlites. Movement along this structure is not indicated by the aeromagnetic data. This trend is cut and offset by a NE/SW left lateral fault that offsets this dike to the south on the west side of the fault.

In general the structures mapped with these aeromagnetic data sets are Precambrian bedrock structures. Structures in the overlying Paleozoic sediments are only mapped in the exceptional case where magnetic material is intruded into those structures.

KIMBERLITES

Kimberlite, an igneous intrusive providing the main mechanism for transporting diamonds from the upper mantle to the earth's surface, was first discovered in Kansas prior to 1920 (Brookins, 1970). The Bala and Stockdale kimberlites were the original outcropping kimberlites to be discovered (Brookins, 1970). Three additional outcropping kimberlites were discovered later. Leonardville in 1935, Randolph No.1 in 1950 and Randolph No.2 in 1950 (Brookins, 1970). The Winkler kimberlite does not outcrop and was not discovered until 1969 when drilling of a circular feature proposed to be a meteorite impact crater intersected kimberlite (Brookins, 1970). Additional discoveries of kimberlites were made in the 1980's by Cominco American (Mansker, 1987). The Swede Creek, Fancy Creek and Lonetree kimberlites were discovered using aeromagnetics and stream sediment geochemistry (Mansker, 1987). In addition, Cominco's work identified three probable kimberlite aeromagnetic anomalies, Baldwin Creek, Tuttle and Antioch which require drill testing prior to joining the list of known kimberlites (Mansker, 1987 and Cominco, 1993). At the time of this report all three have been drilled by the Kansas Geological Survey and are confirmed kimberlites.

Kimberlite is a volatile-rich, potassic, ultrabasic igneous rock that occurs most commonly in continental areas underlain by ancient cratons (Shervais, 1987). The presence of kimberlite intrusives appears to be more a function of the tectonic setting and unrelated to the lithology of the Precambrian basement. They are mantle derived and transported to the surface along deep-seated basement faults. The location of major structures and structural intersections are important in the exploration for kimberlites (Macnae, 1995). Kimberlite intrusions occur as both dikes and diatremes (Macnae, 1995).

Kimberlite is defined petrographically as an inequigranular micaceous peridotite consisting of megacrysts, macrocrysts, phenocrysts and xenocrysts of olivine, phlogopite, picroilmenite, chromian spinel, pyropic garnet, diopside, and/or enstatite set in a finer grained matrix. The matrix typically consists of olivine, phlogopite, carbonate, serpentine, pyroxene, monticellite, apatite, spinels, perovskite and ilmenite (Shervais, 1987).

As the kimberlite intrusion moves to the surface, country rock from both the mantle and the crust are included in the intrusion as xenoliths. The most common mantle derived xenoliths are garnet peridotite and eclogite (Shervais, 1987). Crustal xenoliths typically include altered shale, limestone and sandstone (Shervais, 1987). In fact the crustal xenoliths can include any crustal rock that the kimberlite passes through.

Metosomatic alteration, which is ubiquitous during and after kimberlite emplacement, alters olivine megacrysts to serpentine. In highly altered kimberlite, garnet and ilmenite may be the only megacrysts preserved (Shervais, 1987).

Kimberlites, as ultramafic intrusives, contain more magnetite and are more magnetic then lamprophyres or many other igneous intrusive rocks. Magnetization can be both induced and remenant. It has been empirically observed that where the ground magnetic response of an outcropping kimberlite is greater then 600nT that remnant magnetization is an important component (Macnae, 1995a). The direction of remnant magnetization can be both, normal or reversed, resulting in either a magnetic high or low over the intrusion. Classic kimberlite magnetic anomalies are circular and dipolar. Ellipsoidal to linear magnetic anomalies are more characteristic of kimberlite dikes and multiple adjacent intrusives.

A primary tool for reconnaissance exploration for kimberlites is aeromagnetics. Aeromagnetics can cover large areas of ground quickly and detect small, near surface kimberlite intrusives if the survey is flown with close line spacing, rapid magnetometer sampling and low terrain clearance. These aeromagnetic anomalies are then followed-up by ground geophysics, geochemical sampling and drilling. Kimberlites are easier to identify in areas of flat magnetic relief. For

this reason kimberlite intrusions into non-magnetic Paleozoic sediments in Northeast Kansas are a more easily detected then kimberlites in magneticlly active country rocks.

Multiple magnetic bodies may indicate multiple phases of intrusion (Macnae, 1995a). This can be important to recognize. Not all phases of an intrusion are necessarily diamondiferous. To fully test a kimberlite all phases should be tested. Due to the line spacing and the upward continuation effect of the aircraft terrain clearance the multiple phase character of kimberlite intrusions can seldom be seen directly from the discovery aeromagnetic data set. Ground magnetics is the tool required to identify these multiple phases.

Kimberlites in Kansas

Mansker has divided the kimberlites in Kansas into crater facies, diatreme facies, or hypabyssal facies (Mansker, Richards and Cole, 1987). They are typically magnetite rich, resulting in magnetic amplitudes of 500 to 6300 nT on the ground and 30 to 200 nT in the air. The large, positive, amplitudes indicate that remenant magnetization is present and that the direction of the remanent magnetization is near the direction of the current earths field (Macnae, 1995a). In exploring for new kimberlite intrusives in Kansas the possibility of reverse remenant magnetization and resulting magnetic lows must be kept in mind.

Mansker has proposed an empirical relationship between magnetic anomaly amplitude and facies of the kimberlite. Hypabbysal facies are the most magnetic, diatreme facies next and crater facies the least (Mansker, Richards and Cole, 1987). According to Mansker, Bala, Swede Creek and Randolph No.1 are hypabyssal facies kimberlites having ground magnetic anomalies ranging from 3500nT to 6300nT. Leonardville, Lonetree and Stockdale are diatreme facies kimberlites having ground magnetic anomalies ranging from 2000nT to 3000nT. Winkler, Fancy Creek and the proposed Baldwin Creek kimberlites are crater facies kimberlites and have lower amplitude ground magnetic anomalies ranging from 500nT to 1100nT. The current authors have a difficulty with this empirical relationship. Since the kimberlite bodies are so small the ground magnetic anomaly amplitudes are also a function of kimberlite size, geometry, depth to the top and distance from the nearest survey line. This relationship between facies and magnetic anomaly amplitude is even more tenuous in aeromagnetic data due the small kimberlite size, the survey line spacing and the upward continuation effect of airborne magnetics surveying.

Riley County Kimberlites

Twenty-three short wavelength kimberlite anomalies were identified in the 1981 Riley County aeromagnetic data set. Eight of the magnetic anomalies are known kimberlites. They include Winkler, Swede Creek, Randolph 1, Fancy Creek, Bala, Leonardville, Lone Tree A and Stockdale kimberlites. Randolph 2 and Lonetree B are not observed in the aeromagnetic data. Two other anomalies, Baldwin Creek and Tuttle were suspected kimberlite intrusives and have now been confirmed by Kansas Geological Survey drill holes. Six of the anomalies are obvious cultural features from towns, buildings and bridges. The remaining seven anomalies are generative kimberlite exploration targets and require first pass field checking. One of these eight is high priority.

Appendix I is a list of kimberlite, possible kimberlite and cultural features that have short wavelength aeromagnetic anomalies in Riley County. The approximate legal description for each anomaly is given. The locations are based on observed magnetic anomaly and not modeled sources.

Marshall County Kimberlites

In Marshall County a total of 41 short wavelength anomalies were identified in the 1983 Marshall County aeromagnetic data set. One, the Antioch anomaly was suspected to be a kimberlite and has now been confirmed by a Kansas Geological Survey drill hole. Thirty of the anomalies are likely cultural features from towns, buildings and bridges. The remaining ten anomalies are generative kimberlite exploration targets and require first pass field checking. Three of these ten are high priority.

Appendix II is a list of kimberlites, possible kimberlites and cultural features that have identifiable short wavelength aeromagnetic anomalies in Marshall County. The approximate legal description for each anomaly is given. The locations are based on observed magnetic anomaly and not modeled source.

CONCLUSIONS AND RECOMMENDATIONS

Two detailed, high quality, aeromagnetic data sets were provided to the Kansas Geological Survey by Cominco American Incorporated. The data sets are from Riley County, Kansas (1981) and Marshall County, Kansas (1983). As part of the agreement in providing the data, Cominco requires the disclaimer stating that all interpretive work published by the Kansas Geological Survey is a product of the Survey only and that Cominco has had no involvement in developing these interpretations.

A preliminary, qualitative interpretation of the Riley and Marshall County data sets has been completed and the results are presented in this Open-File report. The interpretation is divided into two parts.

Part 1 is a preliminary geologic map of Precambrian basement along the Mid-Continent Rift System in Northeastern Kansas. Four magnetic terrains are identified that reflect depth to magnetic basement and Precambrian bedrock lithology. Eight mafic or ultramafic intrusives and three alkalic intrusives are interpreted to occur in the survey areas. The major structural sets interpreted from the data are NE/SW trending structures parallel to the Mid-Continent Rift System and NW/SE to E-W trending, cross cutting structures. The NE/SW structures are interpreted to be normal faults with the primary movement being down to the west.

The second part of the interpretation shows the location of known kimberlite intrusions and additional anomalies proposed to be possible kimberlites. A total of sixty-four short wavelength anomalies are identified in the two survey areas. Twenty-three in Riley County of which ten are known kimberlites, two were possible kimberlites that have now been confirmed by Kansas Geological Survey drilling, six are cultural and the remaining five are exploration targets. Forty-one anomalies are identified in Marshall County of which one was suspected to be a kimberlite and has now been confirmed by Kansas Geological Survey drilling, thirty are cultural anomalies and the remaining ten anomalies are exploration targets.

It is recommended that field checking and/or drilling be used to test this interpretation. The primary targets requiring testing are the four magnetic terrains, the mafic and alkalic intrusives and the kimberlite exploration targets.

References Cited

Mansker, W.L., Richards, B.D., and Cole, G.P., 1987, A note on newly discovered kimberlites in Riley County, Kansas: Geological Society of America, Special Paper 215, p. 197-204.

Cominco American Resources, Kansas Diamond Exploration, Internal Company Report, 13 p.

Gunn, P.J., and Dentith, M.C., 1977, Magnetic responses associated with mineral deposits: AGSO Journal of Australian Geology and Geophysics, v.17, no. 2, p. 145-158.

Brookins, D.G., 1970, The Kimberlites of Riley County, Kansas: State Geological Survey of Kansas, Bulletin 200, 32 p.

Shervais, J.W., Taylor, L.A., and Laul, J.C., 1987, Magma mixing and kimberlite genesis; Mineralogic, petrologic, and trace element evidence from eastern U.S.A. kimberlites: Geological Society of America, Special Paper 215, p. 101-114.

Sarma, B.S.P., and Verma, B.K., 1996, Negative Magnetisation contrast in Kimberlite search: Exploration Geophysics, v. 27, p. 21-24.

Macnae, J., 1995, Applications of geophysics for the detection and exploration of kimberlites and lamproites: Journal of Geochemical Exploration, v. 53, p. 213-243.

Macnae, J., 1995, Esoteric and mundane geophysics for diamondiferous pipe exploration: Exploration Geophysics, v. 26, p. 131-137.

Hills, F.A., Scott, R.W., Armbrustmacher, T.J. and Berendsen,P., 1991, Map Showing Distribution of Alkaline Igneous Rocks and Associated Carbonatites and Peridotites in the Northern Midcontinent, U.S.A.: U.S.Geological Survey, Miscellaneous Field Study Map, MF-1835-F, scale 1:1,000,000.

Appendix I

Cominco American Aeromagnetic Survey flown in 1981 by Applied Geophysics Inc. A list of short wavelength anomalies including known kimberlite, possible kimberlite and cultural anomalies.

1. **Winkler Kimberlite**. E1/2 NW1/4 S36 T6S R5E

   Priority: Kimberlite

   Riley County Survey: Sheet 1
   Randolph 1:24,000 Topographic Sheet.

   Aeromagnetic Response

   A large amplitude, 50nT aeromagnetic anomaly, located on a steep magnetic gradient along a NE-SW striking structural zone. The magnetic anomaly shape is circular. The estimated inflection point anomaly width is 1000 feet by 1000 feet.

2. **Magnetic Anomaly** (unnamed). W1/2 SW1/4 S25 T6S R5E
   (Proposed name: School Branch Creek)

   Priority: Low to Moderate

   Riley County Survey Sheet 1
   Randolph 1:24,000 Topographic Sheet

   Aeromagnetic Anomaly

   A low amplitude, 10nT, three contour deflection, aeromagnetic anomaly. The anomaly occurs on a steep magnetic gradient along a NE-SW striking structural zone. The exact size and shape are poorly defined. The estimated inflection point width is 1000 feet by 2000 feet. The anomaly strikes approximately N70E and is located approximately 3000 feet to the NW of the Winkler Kimberlite. It has a possible bedrock source.

3. **Magnetic Anomaly** (unnamed): NW1/4 SW1/4 S19 T6S R6E and
NE1/4 SE1/4 S24 T6S R5E
(Proposed name: North Otter Creek)

Priority: High

Riley County Survey Sheet 1
Greenleaf SE 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A moderate amplitude, <20nT, circular aeromagnetic anomaly located on a steep magnetic gradient along a NE-SW trending structural zone. The estimated inflection point width of the anomaly is1500 feet by 1500 feet. The anomaly is located approximately 9000 feet to the NNE of the Winkler Kimberlite.

4. **Bridge(?)** SE1/4 SE1/4 S4 T7S R6E and NE1/4 NE1/4 S9 T7S R6E

Priority: Low

Riley County Survey Sheet 1
Randolph 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

The anomaly is located at the south edge of a causeway directly over the bridge crossing Tuttle Creek. The anomaly amplitude is a 20nT and its shape is ellipsoidal striking N45E. The estimated inflection point width is 1000 feet by 2000 feet. The source of the anomaly is possibly culture, however, the anomaly shape is not similar to the bridge shape so the anomaly should be field checked.

5. **Swede Creek Kimberlite**: SE1/4 NE1/4 S23 T6S R6E and
SW1/4 NW1/4 S24 T6S R6E.

Priority: Kimberlite

Riley County Survey Sheet 1
Blue Rapids SW 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A large amplitude, >200nT, circular, dipolar, aeromagnetic anomaly in an area of flat magnetic gradient. The estimated inflection point width is 1400 feet by 1400 feet.

6. **Randolph #1 Kimberlite**: S1/2 NW1/4 S35 T6S R6E

Priority: Kimberlite

Riley County Survey Sheet 1
Olsburg NW 1:24,000 Topographic Sheet.

Aeromagnetic Anomaly

A moderate amplitude, >30nT, linear, dike-like, aeromagnetic anomaly striking approximately N80W. The estimated inflection point width is 800 feet by 2000 feet. The anomaly is located between the Swede Creek Kimberlite and the Fancy Creek Kimberlite in an area of flat magnetic gradient.

Randolph #2 Kimberlite (not detected). There is no evidence in the aeromagnetic data set of this body.

7. **Fancy Creek Kimberlite**: SW1/4 NW1/4 S2 T7S R6E

Priority: Kimberlite

Riley County Survey Sheet 1
Olsburg NW 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A large amplitude, >50nT, circular aeromagnetic anomaly located in an area of flat magnetic gradient. The estimated inflection point width is 800 feet by 1000 feet.

8. **Magnetic Anomaly** (unnamed): NE1/4 S11 T7S R6E and
E1/2 NW1/4 S12 T7S R6E
(Proposed name: Blue Tuttle)

Priority: Low

Riley County Survey Sheet 1
Olsburg NW 1:24,000 Topographic Sheet.

Aeromagnetic Anomaly

A small amplitude, 5nT, broad aeromagnetic anomaly located approximately 6000 feet to the SE of the Fancy Creek Kimberlite in an area of flat magnetic gradient. The source location is poorly defined and occurs at the intersection of the Big Blue River and Tuttle Creek. The estimated inflection point width is 3000 feet by 3000 feet. This magnetic anomaly is probably due to a bedrock source.

9. **Bridge Artifact**: SE1/4 S14 T7S R6E

Priority : None

Riley County Survey Sheet 1
Olsburg NW 1:24,000 Topographic Sheet.

Aeromagnetic Anomaly

A small amplitude, <10nT, broad, linear, aeromagnetic anomaly parallel and to the north of the Highway 16 bridge over Tuttle Creek Lake. The source of this anomaly is interpreted to be culture.

10. **Bridge**: N1/2 S23 T7S R6E

Priority: None

Riley County Survey Sheet 1
Olsburg NW 1:24,000 Topographic Sheet.

Aeromagnetic Anomaly

A large amplitude, >50nT, broad, linear, aeromagnetic anomaly directly over the Highway 16 bridge crossing Tuttle Creek lake. The source of the anomaly is interpreted to be culture.

11. **Magnetic Anomaly** (unnamed): S1/2 SE1/4 S14 T6S R6E and N1/2 NE1/4 S23 T 6S R6E.
(Proposed name: Swede Creek North)

Priority: Moderate

Riley County Survey Sheet 1

Blue Rapids SW 1:24,000 Topographic Sheet.

Aeromagnetic Anomaly

A low amplitude, <10 nT, circular magnetic anomaly located 2000 feet to the NW of the Swede Creek Kimberlite. The estimated inflection point width is 800 feet by 800 feet. The anomaly occurs in an area of flat magnetic gradient.

12. **Bala Kimberlite**: NW1/4 NW1/4 S6 T9S R5E

Priority: Kimberlite

Riley County Survey Sheet 2
Bala 1:24,000 Topographic Sheet.

Aeromagnetic Anomaly

A large amplitude, >130nT, circular, aeromagnetic anomaly. It is located on a NNE striking magnetic high in an area of steep gradients and NNE trending structures. The estimated inflection point width is 800 feet by 1000 feet.

13. **Magnetic Anomaly** (culture?): E1/2 NW1/4 S15 T8S R5E

Priority: Low

Riley County Survey Sheet 2
Riley 1:24,000 Topographic Sheet.

Aeromagnetic Anomaly

A low amplitude, 10nT, linear aeromagnetic anomaly within the southern limits of the town of Leonardville. It strikes N15E and occurs in an area of low magnetic gradient to the east of a NNE structure. The estimated inflection point width is 500 feet by 1000 feet. The source of the anomaly is probably culture but should be field checked.

14. **Leonardville Kimberlite**: NE1/4 and SE1/4 of NW1/4 S22 T8S R5E

Priority: Kimberlite

Riley County Survey sheet 2
Riley 1:24,000 Topographic Sheet.

Aeromagnetic Anomaly

A large amplitude, >100nT, circular, dipolar aeromagnetic anomaly located in an area of flat magnetic gradient. The estimated inflection point width is 1400 feet by 1000 feet.

15. **Magnetic anomaly** (culture?): NE1/4 NE1/4 S26 T8S R5E

Priority: None

Riley County Survey Sheet 2
Riley 1:24,000 Topographic Sheet.

Aeromagnetic Anomaly

A low amplitude, 10nT, circular, dipolar aeromagnetic anomaly in an area of flat magnetic gradient. The anomaly is located directly over a high school and the source is probably culture. The estimated inflection point width is 800 feet by 800 feet.

16. **Magnetic anomaly** (culture): SW1/4 SW1/4 S1 T9S R5E

Priority: None

Riley County Survey Sheet 2
Riley 1:24,000 Topographic Sheet.

Aeromagnetic Anomaly

A low amplitude, <10 nT, single contour deflection aeromagnetic anomaly in an area of low magnetic gradient. The anomaly is located within the town site of Riley and is probably due to culture.

17. **Magnetic Anomaly** (unnamed): C Nw1/4 S9 T9S R6E
(Proposed name: Landing Strip)

Priority: Low

Riley County Survey Sheet 2
Riley 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A low amplitude, <10nT, single contour deflection aeromagnetic anomaly within an area of low magnetic gradient. The estimated inflection point width is 1000 feet by 2000 feet.

18. **Magnetic Anomaly** (unnamed): S1/2 NE1/4 S4 T9S R6E
(Proposed name: Grant)

Priority: Low

Riley County Survey Sheet 2
Riley 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A low amplitude, <10nT, single contour deflection, aeromagnetic anomaly in an area of low magnetic gradient. The estimated inflection point width is 1000 feet by 1000 feet.

19. **Magnetic anomaly** (unnamed): NW1/4 S22 T8S R6E
(Proposed name: Tuttle)

Priority: High ***(Confirmed Kimberlite October 1999)***

Riley County Survey Sheet 2
Riley 1:24,000 Topographic Sheet
Olsburg SW 1:24,000 Topographic Sheet.

Aeromagnetic Anomaly

A large amplitude, >50nT, linear dike-like aeromagnetic anomaly in an area of flat magnetic gradient. The anomaly strikes N40W and occurs along the offset projection of the Lonetree to Stockdale trend. A left lateral fault is interpreted to occur between this anomaly and the Lonetree kimberlite. The estimated inflection point width is 800 feet by 2000 feet. Contour deflections occur to the NW and SE for approximately 6000 feet along strike from this anomaly. The entire strike length should be field checked.

20. **Magnetic Anomaly** (Baldwin Creek): SE1/4 SE ¼ S3 T8S R6E

Riley County Survey Sheet 2
Olsburg NW 1:24,000 Topographic Sheet

Priority: High *(Confirmed Kimberlite September 1999)*

Aeromagnetic Anomaly

A large amplitude, >50nT, circular, aeromagnetic anomaly located in an area of low magnetic gradient. The estimated inflection point width is 1000 feet by 1500 feet.

21. **Lonetree (A) Kimberlite**: SE1/4 NW1/4 S23 T8S R6E

Riley County Survey Sheet 2
Olsburg SW 1:24,000 Topographic Sheet

Priority: Kimberlite

Aeromagnetic anomaly

A large amplitude, >50nT, circular, aeromagnetic anomaly occurring in an area of flat magnetic gradient. The anomaly occurs along a NW-SE trending structure connecting it with the Stockdale anomaly approximately 1000 feet to the SE. The structure has a magnetic signature indicating that a kimberlite dike may exist along its 8000 foot strike length. The NW-SE dike structure is offset at it's west end by an interpreted NE-SW left lateral structure. The estimated inflection point width of this anomaly is 800 feet by 800 feet. The Lonetree 2 anomaly is not observed in the aeromagnetic data set.

Lonetree (B) Kimberlite (Not Detected). There is no evidence in the aeromagnetic data set of this body.

22. **Stockdale Kimberlite**: N1/2 SE1/4 S23 T8S R6E

Riley County Survey Sheet 2
Olsburg SW 1:24,000 Topographic Sheet.

Priority: Kimberlite

Aeromagnetic anomaly

A large amplitude, >50nT, ellipsoidal shaped, aeromagnetic anomaly located

in an area of low magnetic gradient. The anomaly strikes NW-SE and occurs along the interpreted NW-SE kimberlite structure running through Lonetree. The Lonetree anomaly is located approximately 1000 feet to the NW. The estimated inflection point width of this anomaly is 1000 feet by 2000 feet.

23. **Magnetic Anomaly** (unnamed): SE1/4 SE1/4 S16 T8S R5E
(Proposed name: Upper Wildcat Creek)

Priority: Low

Riley County Survey Sheet 2
Riley 1:24,000 Topographic Sheet.

Aeromagnetic Anomaly

A low amplitude, <10nT, single contour deflection, aeromagnetic anomaly located along a steep, NNE trending, structurally controlled gradient. The anomaly is located approximately 3000 feet to the NW of the Leonardville Kimberlite. The inflection point width is difficult to measure but is estimated to be less than 800 feet by 800 feet.

Appendix II

Cominco American Aeromagnetic Survey flown in 1983 by Airmag Surveys Inc. A list of short wavelength anomalies including known kimberlite, possible kimberlite and cultural anomalies.

1. **Magnetic Anomaly** (Antioch). NW1/4 NW1/4 S9 T5S R8E

   Priority: High (Confirmed kimberlite, October 1999)

   Marshall County Survey
   Blue Rapids NE 1:24,000 Topographic Sheet

   Aeromagnetic Anomaly

   A moderate amplitude, >10nT, circular aeromagnetic anomaly located on a steep, long wave length, magnetic gradient. The estimated inflection point width of the anomaly is 1000 feet by 1000 feet. There is no culture in the vicinity of this anomaly.

2. **Magnetic Anomaly** (culture?) NE1/4 SW1/4 S9 T5S R8E
   SE1/4 NW1/4 S9 T5S R8E

   Priority: Low

   Marshall County Survey
   Blue Rapids NE 1:24,000 Topographic Sheet

   Aeromagnetic Anomaly

   A low amplitude, <5nT, two contour deflection aeromagnetic anomaly. The anomaly is located directly on the bend of a light duty road, ½ mile south of the Antioch cemetery. The anomaly is located approximately 2500 feet to the SE of the Antioch Kimberlite. The estimated inflection point width of the anomaly is less then 500 feet by 500 feet. The anomaly should be field checked due to it's proximity to the Antioch kimberlite.

3. **Magnetic Anomaly** (unnamed): E1/2 NE1/4 S22 T5S R8E
   W1/2 NW1/4 S23 T5S R8E
   (Proposed name: DeShazer Creek)

Priority: Moderate

Marshall County Survey
Blue Rapids SE 1:24,000 Topographic Sheet
Frankfort SW 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A moderate amplitude, >25nT, large horizontal dimension aeromagnetic anomaly located on a steep, long wave length, magnetic gradient. The anomaly deflects more than 10 contours. The estimated inflection point width of the anomaly is 2000 feet by 2000 feet. There is no culture in the area but the anomaly may be due to a deeper bedrock source.

4. **RR Bridge:** C W1/2 W1/2 S33 T4S R8E

Priority: None

Marshall County Survey
Blue Rapids NE 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A low amplitude, <5nT, three contour deflection aeromagnetic anomaly located on a steep, long wave length magnetic gradient. The estimated inflection point width of the anomaly is 500 feet by 500 feet. The anomaly is directly coincident with a Missouri Pacific railroad bridge crossing Corndodger Creek and is interpreted to be culture.

5. **Buildings:** SE1/4 SE1/4 S18 T4S R8E

Priority: None

Marshall County Survey
Blue Rapids NE 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A low amplitude, <10nT, circular, dipolar aeromagnetic anomaly located on a steep, long wave length magnetic gradient. The estimated inflection point width of the anomaly is 500 feet by 500 feet. The anomaly is coincident with a cluster of buildings and is interpreted to be probable culture.

6 **Buildings(?):** NW1/4 NE1/4 S6 T4S R8E

Priority: Low

Marshall County Survey
Blue Rapids NE 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A low amplitude, <5nT, single contour deflection aeromagnetic anomaly in an area of low magnetic gradient. The estimated inflection point width of the anomaly is 500 feet by 500 feet. The anomaly is coincident with a cluster of buildings. The source is possibly cultural but there is a circular stream deflection in the area and it should be field checked.

7. **Magnetic Anomaly** (unnamed/culture?) SE1/4 SE1/4 S6 T4S R8E

Priority: Low

Marshall County Survey
Blue Rapids NE 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A low amplitude, <5nT, negative deflection on a single contour in an area of low magnetic gradient. The anomaly occurs offset on the north side of a cluster of buildings. This may explain the negative anomaly as a polarization low. The estimated inflection point width of the anomaly is 500 feet by 500 feet. The source of the anomaly is interpreted as possible culture but should be checked out.

8. **Buildings:** SW1/4 NW1/4 S20 T3S R8E

Priority: None

Marshall County Survey
Home 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A low amplitude, <5nT, single contour deflection aeromagnetic anomaly. The anomaly occurs in an area of low magnetic gradient. The estimated inflection

point width of the anomaly is 500 feet by 500 feet. The anomaly is directly coincident with a cluster of buildings and the source is interpreted to be culture.

9. **Magnetic Anomaly(culture?):** NE1/4 NW1/4 S8 T4S R8E

   Priority: Low

   Marshall County Survey
   Blue Rapids NE 1:24,000 Topographic Sheet

   Aeromagnetic Anomaly

   A moderate amplitude, 10nT, circular aeromagnetic anomaly in an area of low magnetic gradient. The estimated inflection point width of the anomaly is 800 feet by 800 feet. The anomaly is directly coincident with a cluster of buildings, however, the amplitude and size of the anomaly indicates the source may be geological and it should be field checked.

10. **Buildings:** SE1/4 SE1/4 S5 T4S R8E

    Priority: None

    Marshall County Survey
    Blue Rapids NE 1:24,000 Topographic Sheet

    Aeromagnetic Anomaly

    A low amplitude, <10nT, circular aeromagnetic anomaly in an area of moderate magnetic gradient. The estimated inflection point width of the anomaly is 800 feet by 800 feet. The anomaly is directly coincident with buildings and is interpreted to be culture.

11. **Magnetic Anomaly(culture):** SE1/4 NE1/4 S5 T4S R8E

    Priority: None

    Marshall County Survey
    Blue Rapids NE 1:24,000 Topographic Sheet

    Aeromagnetic Anomaly

    A low amplitude, <5nT, narrow, single contour deflection aeromagnetic anomaly located immediately to the west of a cluster of buildings in an area

that appears free of culture. The anomaly occurs in an area of moderate magnetic gradient and looks cultural. The estimated inflection point width of the anomaly is 400 feet by 700 feet. The anomaly is interpreted to be culture.

12. **Magnetic Anomaly(unnamed):** C S1/2 S1/2 S21 T3S R8E
(Proposed name: Reedsville)

Priority: Moderate to High

Marshall County Survey
Home 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A moderate amplitude, 15nT, circular, dipolar anomaly located within an area of low magnetic gradient. The estimated inflection point width of the anomaly is 1000 feet by 1000 feet. The anomaly is not coincident with any cultural features.

13. **Magnetic Anomaly(culture)** SW1/4 SW1/4 S2 T4S R8E

Priority: None

Marshall County Survey
Blue Rapids NE 1:24,000 Topographic Sheet
Frankfort 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A low amplitude, <5nT, single contour deflection, aeromagnetic anomaly in an area of low magnetic gradient. The estimated inflection point width of the anomaly is 500 feet by 500 feet. The anomaly occurs near the intersection of light duty roads near a cluster of buildings and is interpreted to be due to culture.

14. **Magnetic Anomaly (culture):** NW1/4 NW1/4 S34 T3S R8E

Priority: None

Marshall County Survey
Home 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A low amplitude, <5nT, single contour deflection aeromagnetic anomaly located within an area of low magnetic gradient. The estimated inflection point width of the anomaly is 800 feet by 800 feet. The anomaly occurs on a light duty road near a cluster of buildings and is interpreted to be culture.

15. **Bridge:** ¼ Corner between S21 and S22 T3S R8E

Priority: None

Marshall County Survey
Home 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A low amplitude, 10nT, circular magnetic anomaly located in an area of low magnetic gradient. The estimated inflection point width of the anomaly is 800 feet by 800 feet. The anomaly is directly coincident with a bridge on a light duty road over Perkins Creek and is adjacent to a cluster of buildings. The source is interpreted to be culture.

16. **Magnetic Anomaly(culture?):** C S1/2 NW1/4 S23 T3S R8E

Priority: Low

Marshall County Survey
Beattie 1:24,000 Topographic Sheet

Aeromagnetic Anomaly

A low amplitude, 5nT, four contour line deflection aeromagnetic anomaly located in an area of moderate magnetic gradient. The estimated inflection point width of the anomaly is 500 feet by 1000 feet. The anomaly is located just to the south and immediately adjacent to the Union Pacific railroad and immediately to the north of Perkins Creek. The anomaly is interpreted as possible culture but requires field checking due to the offset from the railroad.

17. **RR/Building:** W1/2 NW1/4 S25 T3S R8E

Priority: None

Marshall County Survey

Beattie 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A low amplitude, 5 to 10nT, two contour line deflection aeromagnetic anomaly in an area of moderate magnetic gradient. The estimated inflection point width of the anomaly is 600 feet by 600 feet. The source is directly coincident with a building along side of the Union Pacific railroad and siding and is interpreted to be due to culture.

18. **RR Bridge:** SE1/4 SE1/4 S26 T4S R8E

Priority: None

Marshall County Survey
Frankfort 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A low amplitude, <5nT, single contour deflection, aeromagnetic anomaly in an area of moderate magnetic gradient. The estimated inflection point width of the anomaly is 600 feet by 600 feet. The source is directly coincident with a Missouri-Pacific railroad bridge across the Johnson Fork and is interpreted to be due to culture.

19. **Bridge:** SE1/4 SE1/4 S1 T5S R8E
SW1/4 SW1/4 S6 T5S R9E

Priority: None

Marshall County Survey
Frankfort 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A weak, <5nT, single contour deflection, aeromagnetic anomaly located in an area of low magnetic gradient. Coincident with a bridge on a light duty road over the Clear Fork. The source is interpreted to be probable culture.

20. **Bridge/Buildings:** C N1/2 NW1/4 S30 T3S R8E

Priority: None

Marshall County Survey

Beattie 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A low amplitude, 5nT, two contour line deflection aeromagnetic anomaly located within an area of moderate magnetic gradient. The estimated inflection point width of the anomaly is 600 feet by 600 feet. The anomaly is coincident with both a cluster of buildings and a bridge/culvert on a light duty road over the Robidoux Creek. The source is interpreted to be due to culture.

21. **Magnetic Anomaly(unnamed):** SE1/4 SE1/4 S30 T3S R9E
(Proposed name: Snipe Creek)

Priority: Moderate

Marshall County Survey
Beattie 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A moderate amplitude, >10nT, broad lateral extent, aeromagnetic anomaly located in an area of steep magnetic gradient. The estimated inflection point width of the anomaly is 1000 feet by 1000 feet. There is no culture in the area. The source may be due to a bedrock feature.

22. **Magnetic Anomaly(culture?):** NW1/4 NW1/4 S5 T4S R9E

Priority: Low

Marshall County Survey
Frankfort 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A low amplitude, 5nT, small lateral extent, aeromagnetic anomaly in an area of low magnetic gradient. The estimated inflection point width of the anomaly is 400 feet by 600 feet. The source is offset to the east from the Union Pacific railroad and railroad bridge. The source is offset to the south of an unimproved road and bridge. The source is interpreted to be possible culture but requires field checking due to its offset into a field, slightly away from culture.

23. **Railroad/Dike/Buildings:** W1/2 NW1/4 S16 T4S R9E

Priority: None

Marshall County Survey
Frankfort 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A moderate amplitude, 15nT, aeromagnetic anomaly in an area of large magnetic gradient. The estimated inflection point width of the anomaly is 500 feet by 500 feet. The anomaly is directly coincident with the Union Pacific railroad built up onto a dike. The source is interpreted to be culture.

24. **Town site(Frankfort):** NE1/4 SW1/4 S16 T4S R9E

Priority: None

Marshall County Survey
Frankfort 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A moderate amplitude, 20nT, aeromagnetic anomaly located within an area of large magnetic gradient. The estimated inflection point width of the anomaly is 600 feet by 600 feet. The source is directly coincident with downtown Frankfort and is interpreted to be culture.

25. **Railroad Bridge:** SW1/4 SE1/4 S16 T4S R9E

Priority: None

Marshall County Survey
Frankfort 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A moderate amplitude, 20nT, aeromagnetic anomaly located within an area of large magnetic gradient. The estimated inflection point width of the anomaly is 600 feet by 600 feet. The source of the anomaly is directly coincident with a major Union Pacific railroad bridge across the Black Vermillion River to the south of the city of Frankfort. The source is interpreted to be culture.

26. **Magnetic Anomaly (unnamed):** SW1/4 NE1/4 S21 T4S R9E
(Proposed name: Black Vermillion)

Priority: Low

Marshall County Survey
Frankfort 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A low amplitude, 5nT, aeromagnetic anomaly in an area of steep magnetic gradient. The estimated inflection point width of the anomaly is 300 feet by 300 feet. The magnetic anomaly looks cultural but occurs in an area where no culture is indicated on the topographic map. Field checking is required.

27. **Buildings:** NE1/4 NW1/4 S34 T4S R9E

Priority: None

Marshall County Survey
Frankfort 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A low amplitude, <10nT, aeromagnetic anomaly located in an area of steep magnetic gradient. The estimated inflection point width of the anomaly is 400 feet by 400 feet. The source appears to be coincident or slightly offset from a cluster of buildings. The source is interpreted to be culture.

28. **Magnetic Anomaly (unnamed):** NW1/4 SW1/4 S15 T5S R9E
(Proposed name: Jim Creek)

Priority: Moderate

Marshall County Survey
Frankfort SW 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A moderate amplitude, 15nT, broad, aeromagnetic anomaly in a magnetically active area and large magnetic gradients. The estimated inflection point width of the anomaly is 1000 feet by 1000 feet. The anomaly occurs on a secondary highway, near a cluster of houses but is too broad to be due solely to culture. The source is possible a deeper basement source.

29. **Bridge:** SW1/4 NW1/4 S27 T5S R9E

Priority: None

Marshall County Survey
Frankfort SW 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A low amplitude, <5nT, aeromagnetic anomaly in an area of large magnetic gradient. The estimated inflection point width is 300 feet by 300 feet. The source is directly coincident with a bridge on highway 99 over the Clear Fork River. The source is interpreted to be culture.

30. **Buildings:** NW1/4 NE1/4 S26 T5S R9E

Priority: None

Marshall County Survey
Frankfort SW 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A low amplitude, <5nT, single contour deflection aeromagnetic anomaly in an area of moderate magnetic gradient. The anomaly has a small lateral dimension and looks typical of culture. The estimated inflection point width of the anomaly is 300 feet by 300 feet. The source is coincident with a cluster of buildings and is interpreted to be culture.

31. **Magnetic Anomaly (unnamed):** S1/2 NW1/4 S11 T5S R9E
(Proposed name: Clear Fork)

Priority: High

Marshall County Survey
Frankfort 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A moderate amplitude, 20nT, broad, aeromagnetic anomaly in a magnetically active and moderate magnetic gradient area. The estimated inflection point width of the anomaly is 1000 feet by 1000 feet. No culture occurs in the

vicinity of the anomaly. The source may be a basement magnetic feature. Field checking of the anomaly is required.

32. **Magnetic Anomaly(culture?):** C S1/2 S1/2 S23 T4S R9E

Priority: Low

Marshall County Survey
Frankfort 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A moderate amplitude, 20nT, broad, aeromagnetic anomaly occurring in a Magnetically active and steep gradient area. The estimated inflection point width of the anomaly is 800 feet by 1000 feet. The anomaly is directly coincident with a Union Pacific railroad bridge over Irish Creek. The anomaly looks too broad to be cultural and may actually be a combination of culture and bedrock source. Field checking is required.

33. **Magnetic Anomaly(unnamed):** SE1/4 NE1/4 S22 T3S R9E
(Proposed name: Little Timber Creek)

Priority: Moderate to High

Marshall County Survey
Beattie 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A large amplitude, 35nT, broad aeromagnetic anomaly in a magnetically active and large gradient area. The estimated inflection point width of the anomaly is 1200 feet by 1600 feet. The source does not appear to be related to culture but may be a bedrock feature. This anomaly requires field checking.

34. **Magnetic Anomaly (unnamed):** S1/2 SE1/4 S15 T3S R9E
(Proposed name: Rock Low)

Priority: Moderate

Marshall County Survey
Beattie 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A large negative amplitude, -30nT, broad, aeromagnetic anomaly located in a magnetically active and large gradient area. The estimated inflection point width of the anomaly is 800 feet by 800 feet. No culture occurs in the vicinity of the anomaly. The source may be a bedrock feature. Field checking of this anomaly is required.

35. **Magnetic Anomaly(unnamed):** C N1/2 NW1/4 S1 T4S R9E
(Proposed name: Ackerman Creek)

Priority: High

Marshall County Survey
Vermillion 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A large amplitude, <20nT, broad, aeromagnetic anomaly in an area of active magnetics and large magnetic gradients. The estimated inflection point width of the anomaly is 800 feet by 1000 feet. No obvious culture occurs in the vicinity however a portion of the anomaly is coincident with a pond and earth dam. The source of the anomaly could be a bedrock magnetic body.

36. **Culture/RR(?):** 1600' North of SW Sec. Corner of S8 T4S R9E

Priority: Low

Marshall County Survey
Vermillion 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A large amplitude, >75nT, broad, aeromagnetic anomaly located within a magnetically active area with large magnetic gradients. The estimated inflection point width is 1000 feet by 1000 feet. The magnetic anomaly does not look cultural but appears to have a bedrock source. The source is directly coincident with the town site of Vliets and the Missouri Pacific railroad. The cultural anomaly may be hidden by the strong bedrock anomaly. The source is interpreted to be possible culture/bedrock.

37. **Bridge:** 2000' North of SW Sec. Corner S5 T5S R10E

Priority: None

Marshall County Survey
Vermillion 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A low amplitude, <10nT, aeromagnetic anomaly located in a magnetically active area on a steep magnetic gradient. The estimated inflection point width is 400 feet by 400 feet. The anomaly looks cultural and the source is directly coincident with a light duty road bridge crossing Irish Creek. The source is interpreted to be culture.

38. **Buildings:** C W1/2 SW1/4 S19 T5S R10E

Priority: None

Marshall County Survey
Wheaton 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A low amplitude, <5nT, aeromagnetic anomaly in an area of moderate magnetic gradient and activity. The estimated inflection point width of the anomaly is 600 feet by 600 feet. The source is directly coincident with a cluster of buildings and is interpreted to be culture.

39. **Buildings:**C N1/2 NW1/4 S30 T5S R10E

Priority: None

Marshall County Survey
Wheaton 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A low amplitude, <5nT, aeromagnetic anomaly located within an area of moderate magnetic gradient and activity. The estimated inflection point width of the anomaly is 600 feet by 600 feet. The source is directly coincident with a cluster of buildings and is interpreted to be culture.

40. **Railroad:** C W1/2 NE1/4 S16 T5S R10E

Priority: None

Marshall County Survey
Wheaton 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A low amplitude, <5nT, aeromagnetic anomaly located in an area of moderate magnetic activity and gradient. The estimated inflection point width of the anomaly is 600 feet by 600 feet. The source is directly coincident with the Union Pacific railroad and is interpreted to be culture.

41. **Railroad/Buildings:** SE1/4 SE1/4 S16 T5S R10E

Priority: None

Marshall County Survey
Wheaton 1:24,000 Topographic Sheet

Aeromagnetic Anomaly Description

A moderate amplitude, 15nT, aeromagnetic anomaly in an area of steep magnetic gradient and high magnetic activity. The estimated inflection point width of the anomaly is 800 feet by 800 feet. The source is directly coincident with the Union Pacific railroad and buildings to the west of the town site of Lillis. The source is interpreted to be culture.